Giga-tronics

PRELIMINARY

Operating and Maintenance Manual

8540 Series

Universal Power Meters

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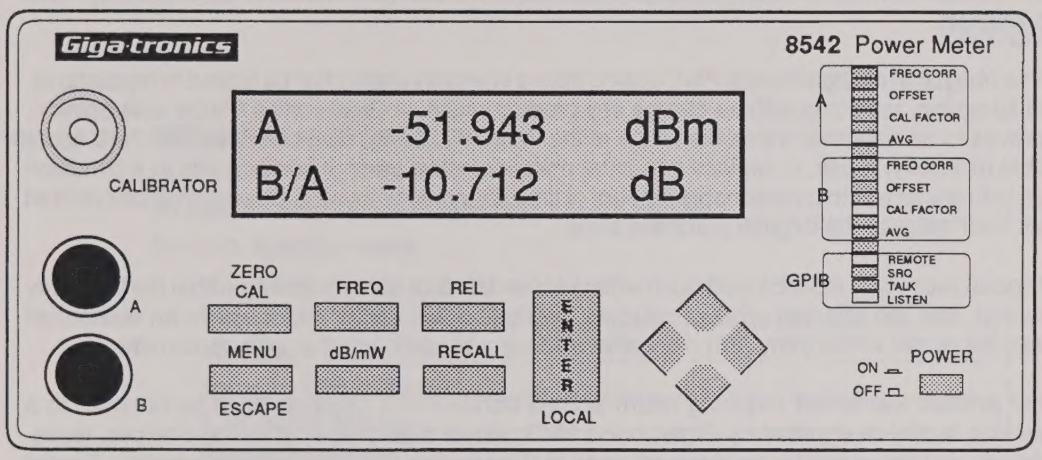
8540 Series
Universal Power Meters



PRELIMINARY

Operating and Maintenance Manual

INSTRUMENT SERIAL NUMBER _____

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Power Measurements Division

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CHAPTER 1

GENERAL INFORMATION

About the 8540 Series Universal Power Meters

The 8540 Series Universal Power Meters consist of the Model 8541 single input unit, and the Model 8542 which is a dual channel unit that can simultaneously measure and display signal data for two channels as desired. Both units have a backlit LCD display which is easily read in all lighting conditions and over a wide viewing range. A 20 segment LCD bargraph functions as a peaking meter.

Using a wide range of fast reading diode based power sensors and new burst modes, the meters provide a reading speed of >200 triggered readings per second in the CW mode, and >2000 readings per second in the burst mode. Three Triggering modes are available: fast free-run, fast bus triggered, and fast TTL triggered modes.

Eight burst modes are available, with power readings internally buffered for readout at the completion of the burst interval. Standard buffer size is 5000 readings (or about 2.1 seconds at the maximum reading rate). The Option 02 buffer increases this to 128,000 readings.

Main features of the 8540 Series include the following:

- >2000 readings/second in Burst Mode (GPIB only)
- 90 dB dynamic range sensors
- CW and Pulse sensors
- ±0.5% linearity
- True dual channel display
- HP438A, 437B, and 436 simulation modes (GPIB only)
- PROM based CAL FACTOR correction sensors

System Specifications

METER

Frequency Range:
10 MHz to 40 GHz, depending on sensor used.

Power Range:
+47 dBm to -70 dBm (50 Watt to 100 pW), depending on sensor used.

Dynamic Range:
90 dB with CW sensors, 40 dB with Pulse sensors.

Display Resolution:
User selectable from 1 dB to 0.001 dB in Log mode, and from 3 to 6 digits of display resolution is Linear mode.

ACCURACY

Calibrator:

Provides a 50 MHz calibration signal at 51 controlled steps from -30 to +20 dBm to dynamically linearize the sensor.

Frequency:	50 mHz, nominal
Settability:	1 mW ±0.7% (traceable to NIST)
Accuracy:	±1.2 worst case for 1 year, over temperature range 15° to 35°C.
Connector:	Type N(f) precision, 50Ω
VSWR:	<1.05 (Return loss >33 dB)

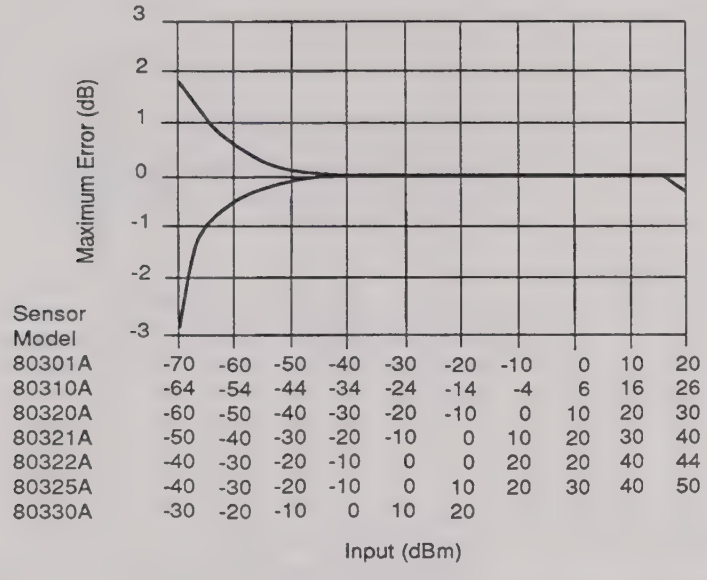
Instrument Linearity at 50 MHz:

±0.02 dB over any 20 dB range from +16 to -70 dBm (see graph at the top of page 1-3).
±0.02 dB + (+0dB, -0.05 dB/dB) from +16 to +20 dBm.
±0.04 dB (±1%) from +16 to -70 dBm.

Zeroing Accuracy:

Zero Set:	±50 pW
Zero Drift:	Typically <±100 pW in 1 hour at constant temperature after a 24 hour warmup.

Noise Uncertainty: Typically <50 pW, at constant temperature measured over a 1 minute interval, two standard deviations.



Sensor Model										
80301A	-70	-60	-50	-40	-30	-20	-10	0	10	20
80310A	-64	-54	-44	-34	-24	-14	-4	6	16	26
80320A	-60	-50	-40	-30	-20	-10	0	10	20	30
80321A	-50	-40	-30	-20	-10	0	10	20	30	40
80322A	-40	-30	-20	-10	0	0	20	20	40	44
80325A	-40	-30	-20	-10	0	10	20	30	40	50
80330A	-30	-20	-10	0	10	20				

Figure 1-1. Uncertainty Due to Instrument Linearity and Zero Set vs Input Power

REMOTE OPERATION

GPIB INTERFACE: Allows all front panel operations, and some GPIB only operations, to be remotely programmed in either IEEE-488 or IEC-625 formats.

INTERRUPTS: SRQs are generated for the following conditions:

Power Up, Front Panel key pressed, Operation Complete, Illegal Command, and Instrument Self-Test error.

CW BURST MODES

BURST 1: TTL trigger, post trigger readings saved.

BURST 2: GPIB trigger, post trigger readings saved.

BURST 3: GPIB trigger, pre trigger readings saved.

BURST 4: GPIB trigger,, pre trigger readings saved.

BURSTS 5 - 8: As for B1 - B4 with programmable reading speed.

METER FUNCTIONS

AVERAGING: User selectable, averaging from 1 to 512 readings.

dB REL AND OFFSET: Allows both relative readings and offset readings. Power display can be offset by -99.99 to +99.99 dB to account for external loss/gain.

STORAGE REGISTERS: Allows up to 20 front panel setups plus a power down last instrument state to be stored and recalled from non-volatile memory.

INPUTS / OUTPUTS

V PROP F INPUT (BNC): Used to correct power readings for sensor frequency response using sweeper voltage output. (Input resistance = 50k)

ANALOG OUTPUT (BNC): Provides an output voltage of 0 to 10V from either Channel 1 or Channel 2 in either Log or Lin units.

BLANKING OUTPUT (BNC): TTL high during power meter zero. Can be used to shut off signal generator RF during sensor zero.

TRIGGER INPUT (BNC): Used to connect TTL trigger input signal (rising edge triggered) for Fast CW triggered and burst signals.

GPIB CONNECTOR: Used to connect power meter to controller.

GENERAL SPECIFICATIONS

TEMPERATURE RANGE:

Operating: 0° to 50°C (+32° to +122°F)
Storage: -40° to +70°C (-40° to +158°F)

POWER REQUIREMENTS:

100/120/220/240V ±10%, 48 to 440 Hz, 20VA typical

PHYSICAL CHARACTERISTICS:

Dimensions: 215 mm (8.4 in) wide, 89 mm (3.5 in) high, 368 mm (14.5 in) deep
Weight: 4.55 kg (10 lbs)

ACCESSORIES

1 ea 8540 Series Operating and Maintenance Manual
1 ea Power Cord
1 ea Detachable Sensor Cable (for Model 8541)
or
2 ea Detachable Sensor Cables (for Model 8542)

CW POWER SENSOR SELECTION GUIDE

Model	Frequency Range / Power Range	Maximum Power	Power Linearity [4] (Freq >8 GHz)	VSWR	RF Connector	Dimensions		Weight
						Length	Diameter	
STANDARD CW SENSORS								
[illegible]A	10 MHz to 18 GHz -70 to +20 dBm	+23 dBm (200 mW)	-70 to -20 dBm: ±0.00 dB -20 to +20 dBm ±0.05 dB/10 dB	10 MHz - 2 GHz 1.12 2 GHz - 12.4 GHz 1.22 12.4 GHz - 18 GHz 1.29	Type N(m) 50Ω	114.5 mm (4.5 in)	32 mm (1.25 in)	0.18 kg (0.4 lb)
80302A	10 MHz to 18 GHz -70 to +20 dBm	+23 dBm (200 mW)	-70 to +20 dBm: ±0.00 dB -20 to +20 dBm ±0.05 dB/10 dB	10 MHz - 2 GHz 1.12 2 GHz - 12.4 GHz 1.22 12.4 GHz - 18 GHz 1.29	APC-7 50Ω	114.5 mm (4.5 in)	32 mm (1.25 in)	0.18 kg (0.4 lb)
[illegible]3A	10 MHz to 26.5 GHz -70 to +20 dBm	+23 dBm (200 mW)	-70 to +20 dBm: ±0.00 dB -20 to +20 dBm: ±0.1 dB/10 dB	10 MHz - 2 GHz 1.12 2 GHz - 12.4 GHz 1.22 12.4 GHz - 18 GHz 1.38 18 GHz - 26.5 GHz 1.43	Type K(m) [1] 50Ω	114.5 mm (4.5 in)	32 mm (1.25 in)	0.18 kg (0.4 lb)
[illegible]4A	10 MHz to 40 GHz -70 to 0 dBm	+23 dBm (200 mW)	-70 to -20 dBm: ±0.00 dB -20 to 0 dBm ±0.2 dB/10 dB	10 MHz - 2 GHz 1.12 2 GHz - 12.4 GHz 1.22 12.4 GHz - 18 GHz 1.38 18 GHz - 26.5 GHz 1.43 26.5 GHz - 40 GHz 1.92	Type K(m) [1] 50Ω	114.5 mm (4.5 in)	32 mm (1.25 in)	0.23 kg (0.5 lb)
LOW VSWR SENSORS								
[illegible]11A	10 MHz to 18 GHz -64 to +20 dBm	+29 dBm (800 mW)	-64 to -14 dBm: ±0.00 dB -14 to +20 dBm: ±0.05 dB/10 dB	10 MHz - 2 GHz 1.13 2 GHz - 12 GHz 1.16	Type K(m) [1] 50Ω	127 mm (5.0 in)	32 mm (1.25 in)	0.23 kg (0.5 lb)
80313A	10 MHz to 26.5 GHz -64 to +20 dBm		-64 to -14 dBm: ±0.00 dB -14 to +20 dBm: ±0.1 dB/10 dB	12 GHz - 18 GHz 1.23 18 GHz - 265 GHz 1.29 265. GHz - 40 GHz 1.50				
80314A	10 MHz to 40 GHz -64 to +6 dBm		-64 to -14 dBm: ±0.00 dB -14 to +6 dBm: ±0.2 dB/10 dB					
1W CW SENSORS								
[illegible]20A	10 MHz to 18 GHz -60 to +30 dBm	+30 dBm (1 W)	-60 to -10 dBm: ±0.00 dB -10 to +30 dBm ±0.05 dB/10 dB	10 MHz - 2 GHz 1.11 2 GHz - 12 GHz 1.12	Type K(m) [1] 50Ω	127 mm (5.0 in)	32 mm (1.25 in)	0.23 kg (0.5 lb)
[illegible]23A	10 MHz to 26.5 GHz -60 to +30 dBm		-60 to -10 dBm: ±0.00 dB -10 to +30 dBm ±0.1 dB/10 dB	12 GHz - 18 GHz 1.18 18 GHz - 26.5 GHz 1.22 26.5 GHz - 40 GHz 1.36				
[illegible]24A	10 MHz to 40 GHz -60 to +30 dBm		-60 to -10 dBm: ±0.00 dB -10 to +30 dBm ±0.2 dB/10 dB					
5W CW SENSOR [3]								
80321A	10 MHz to 18 GHz -50 to +37 dBm	+37 dBm (5 W)	-50 to 0 dBm: ±0.00 dB 0 to +37 dBm ±0.05 dB/10 dB	10 MHz - 4 GHz 1.15 4 GHz - 8 GHz 1.20 8 GHz - 12.4 GHz 1.25 12.4 - 18 GHz 1.35	Type N(m) 50Ω	150 mm (5.9 in)	32 mm (1.25 in)	0.23 kg (0.5 lb)
25W CW SENSOR [3]								
[illegible]22A	10 MHz to 18 GHz -40 to +44 dBm	+44 dBm (25 W)	-40 to +10 dBm ±0.00 dB +10 to +44 dBm ±0.05 dB/10 dB	10 MHz - 6 GHz 1.20 6 GHz - 12.4 GHz 1.30 12.4 GHz - 18 GHz 1.40	Type N(m) 50Ω	230 mm (9.0 in)	104 mm (4.1 in)	0.5 kg (1.6 lb)
50W CW SENSOR [3]								
80325A	10 MHz to 18 GHz -40 to +47 dBm	+47 dBm (50 W)	-40 to +10 dBm ±0.00 dB +10 to +47 dBm ±0.05 dB/10 dB	10 MHz - 6 GHz 1.25 6 GHz - 12.4 GHz 1.35 12.4 GHz - 18 GHz 1.45	Type N(m) 50Ω	230 mm (9.0 in)	104 mm (4.1 in)	0.3 kg (0.6 lb)
TRUE RMS SENSORS (-30 to +20 dBm)								
[illegible]26A [illegible]27A	10 MHz to 18 GHz 10 MHz to 26.5 GHz [illegible] MHz to 40 GHz	+33 dBm (2 W)	-30 to +20 dBm ±0.00 dB	10 MHz - 12 GHz 1.12 12 GHz - 18 GHz 1.25 18 GHz - 26.5 GHz 1.33 26.5 GHz - 40 GHz 1.29	Type K(m) 50Ω	152.5 mm (6.0 in)	32 mm (1.25 in)	0.27 kg (0.6 lb)

PEAK POWER SENSOR SELECTION GUIDE

Model	Frequency Range / Power Range	Maximum Power	Power Linearity [4]	VSWR	RF Connector	Dimensions		Weight
						Length	Diameter	
STANDARD PEAK POWER SENSORS								
80350A	45 MHz to 18 GHz -20 to +20 dBm, Peak -30 to +20 dBm, CW	+23 dBm (200 mW) CW or Peak	-30 to -20 dBm: ±0.13 dB -20 to +20 dBm:±0.13 dB ±0.05 dB/10dB	45 MHz - 2 GHz: 1.12 2 GHz - 12.4 GHz: 1.22 12.4 GHz - 18 GHz: 1.37	Type N(m) 50Ω	? mm (? in)	37 mm (1.25 in)	0.3 kg (0.7 lb)
80353A	45 MHz to 26.5 GHz -20 to +20 dBm, Peak -30 to +20 dBm, CW	+23 dBm (200 mW) CW or Peak	-30 to -20 dBm: ±0.13 dB -20 to +20 dBm:±0.13 dB ±0.1 dB/10dB	45 MHz - 2 GHz: 1.12 2 GHz - 12.4 GHz: 1.22 12.4 GHz - 18 GHz: 1.37 18 GHz - 26.5 GHz: 1.50	Type K(m) [1] 50Ω	? mm (? in)	37 mm (1.25 in)	0.3 kg (0.7 lb)
80354A	45 MHz to 40 GHz -20 to +0.0 dBm, Peak -30 to +0.0 dBm, CW	+23 dBm (200 mW) CW or Peak	-30 to -20 dBm: ±0.13 dB -20 to 0.0 dBm: ±0.13 dB ±0.2 dB/10dB	45 MHz - 2 GHz: 1.12 2 GHz - 12.4 GHz: 1.22 12.4 GHz - 18 GHz: 1.37 18 GHz - 26.5 GHz: 1.50 26.5 GHz - 40 GHz: 1.92	Type K(m) [1] 50Ω	? mm (? in)	37 mm (1.25 in)	0.3 kg (0.7 lb)
5W PEAK POWER SENSOR [2,5]								
80351A	45 MHz to 18 GHz 0.0 to +40 dBm, Peak -10 to +37 dBm, CW	CW: +37 dBm (5 W Avg.) Peak: +43 dBm	-10 to +0 dBm: ±0.13 dB +0 to +40 dBm±0.13 dB ±0.05 dB/10dB	45 MHz - 4 GHz: 1.15 4 GHz - 12.4 GHz: 1.25 12.4 GHz - 18 GHz: 1.35	Type N(m) 50Ω	? mm (? in)	37 mm (1.25 in)	0.3 kg (0.7 lb)
25W PEAK POWER SENSOR [3,5]								
80352A	45 MHz to 18 GHz +10 to +50 dBm, Peak 0.0 to +44 dBm, CW	CW: +44 dBm (25 W Avg.) Peak: +53 dBm	0.0 to +10 dBm±0.13 dB +10 to +50 dBm: ±0.13 dB ±0.05 dB/10dB	45 MHz - 6 GHz: 1.20 6 GHz - 12.4 GHz: 1.30 12.4 GHz - 18 GHz: 1.40	Type N(m) 50Ω	? mm (? in)	104 mm (4.1 in)	0.3 kg (0.7 lb)
50W PEAK POWER SENSOR [3,5]								
80355A	45 MHz to 18 GHz +10 to +50 dBm, Peak 0.0 to +47 dBm, CW	CW: +47 dBm (50 W Avg.) Peak: +53 dBm	0.0 to +10 dBm: ±0.13 dB +10 to +50 dBm: ±0.13 dB ±0.05 dB/10dB	45 MHz - 6 GHz: 1.25 6 GHz - 12.4 GHz: 1.31 12.4 GHz - 18 GHz: 1.45	Type N(m) 50Ω	? mm (? in)	104 mm (4.1 in)	0.3 kg (0.7 lb)

POWER SENSOR CAL FACTOR UNCERTAINTIES

Freq. (GHz)		Sum of Uncertainties (%) [6]						Probable Uncertainties (%) [7]					
Lower	Upper	80301A 80302A 80350A	80303A 80304A 80353A 80354A	80310A 80313A 80314A	80320A 80323A 80324A	80321A [8] 80322A 80325A 80351A [8] 80352A [8] 80353A [8]	80330A 80333A 80334A	80301A 80302A 80350A	80303A 80304A 80353A 80354A	80310A 80313A 80314A	80320A 80323A 80324A	80321A [8] 80322A 80325A 80351A [8] 80352A [8] 80353A [8]	80330A 80333A 80334A
0.1	1	1.61	3.06	2.98	2.96	7.61	2.95	1.04	1.64	1.58	1.58	4.54	1.58
1	2	1,95	3.51	3.58	3.57	7.95	3.55	1.20	1.73	1.73	1.73	4.67	1.73
2	4	2.44	4.42	4.33	4.29	8.44	4.27	1.33	1.93	1.91	1.91	4.89	1.90
4	6	2.67	4.74	4.67	4.63	8.67	4.60	1.41	2.03	2.02	2.01	5.01	2.01
6	8	2.86	4.94	4.87	4.82	8.86	4.80	1.52	2.08	2.07	2.06	5.12	2.06
8	12.4	3.59	6.04	5.95	5.90	9.59	5.87	1.92	2.55	2.54	2.53	5.56	2.53
12.4	18	4.09	6.86	6.76	6.69	10.09	6.64	2.11	2.83	2.80	2.79	5.89	2.78
18	26.5	---	9.27	9.43	9.28	----	9.21	---	3.63	3.68	3.62	----	3.59
26.5	40	---	15.19	14.20	13.86	----	13.66	---	6.05	5.54	5.39	----	5.30

[1] The K connector is electrically and mechanically compatible with the APC-3.5 and SMA connectors.
[2] Power coefficient equals <0.01 dB/Watt.
[3] Power coefficient equals <0.015 dB/Watt.
[4] For frequencies above 8 GHz, add power linearity to system linearity.
[5] Peak operating range above CW maximum range is limited to <10% duty cycle.
[6] Includes uncertainty of reference standard and transfer uncertainty. Directly traceable to NIST.
[7] Square root of sum of the individual uncertainties squared (RSS).
[8] Uncertainties include 3% repeatability when re-connecting attenuator to sensor, and 3% for attenuator measurement uncertainty. Attenuator frequency response is added to the Sensor Cal Factors which are stored in the sensor EEPROM.

GIGA-TRONICS 80350A SERIES PEAK POWER SENSOR SPECIFICATIONS

Frequency Range: [1]
45 MHz to 18 GHz (Type N Connector)
45 MHz to 26.5 GHz (Type K Connector)
45 MHz to 40 GHz (Type K Connector)

Peak Power Dynamic Range: [1]
Measurement: +20 to -20 dBm (Peak)
+20 to -30 dBm (CW)
Absolute Maximum: +23 dBm

Return Loss (VSWR):
(See VSWR column of the Peak Power Selection Guide on page 1-7.)

Temperature Coefficient of Linearity:
±0.5%/°C, from 20° to 30°C
±1.5%/°C, from 0° to 20°C and 30° to 50°C

Zeroing Accuracy:
Zero Set: *<±0.05 nW* [2]
Zero Drift: *<±50 nW* [2] in 1 hour at constant temperature after 1 hour warmup. *Typical = ≤0.04 µW*

Noise Uncertainty:
<±0.05 mW [2], at constant temperature, measured over a 1 minute interval, three standard deviations

Rise Time: (10% to 90%, 0 dBm = 100%)
<100 nS *(Typical = ≤80 ns)*

Fall Time: (90% to 10%, 0 dBm = 100%)
<200 nS *(Typical = ≤140 ns)*

Control Inputs / Outputs:
Trigger Input: [SMB(m) connector] External trigger input rated to 10V. 1kΩ Impedance. Opt 1, 1 dB attenuator matches Ωs on fast 50Ω sources.
Detector Out: [SMB(m) connector] Monitor real time pulse waveform and sample point on an oscilloscope with this voltage output (uncalibrated).
Sample Delay Out: [SMB(m) connector] High, 5V, between trigger and sample points. Connect to scope z-axis.

[1] Sensor Dependent
[2] Applies to 80350A, 80353A, and 80354A. 80351A is 10x larger, 80352A is 100x larger.

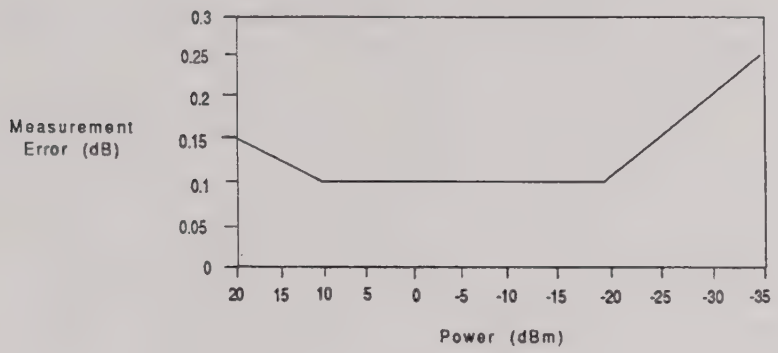
DIRECTIONAL BRIDGES

The 80500 Series of Directional Bridges are designed specifically for use with the 8540 Series Power Meters to measure the return loss of a test device. Each bridge includes an EEPROM which has been programmed with Identification Data for that bridge.

Directional Bridge Specifications

Model No	Frequency Range	Directivity (dB)	Input Connector	Test Port Connector	Test Port Match (SWR)	Dimensions	Weight
80501	0.01 to 18 GHz	38	N(f)	N(f)	0.01 - 8 GHz: <1.17 8 - 18 GHz: <1.27	7.6 x 5 x 2.8 cm (3 x 2 x 1 1/8 in)	340 g (12 oz)
80502	0.01 to 18 GHz	40	N(f)	APC-7	0.01 - 8 GHz: <1.13 8 - 18 GHz: <1.22	7.6 x 5 x 2.8 cm (3 x 2 x 1 1/8 in)	340 g (12 oz)
80503	0.01 to 26.5 GHz	35	WSMA(f)	WSMA(f)	0.01 - 8 GHz: <1.22 8 - 18 GHz: <1.22 18 - 26.5 GHz: <1.27	1.9 x 3.8 x 2.9 cm (3/4 x 1 1/2 x 2 1/8 in)	198 g (7 oz)
80504	0.01 to 40 GHz	30	K(f)	K(f)	0.01 - 8 GHz: <1.35 8 - 18 GHz: <1.35 18 - 26.5 GHz: <1.35 26.5 - 40 GHz: <1.44	1.9 x 3.8 x 2.9 cm (3/4 x 1 1/2 x 2 1/8 in)	198 g (7 oz)

Directional Bridge Linearity Plus Zero Set and Noise vs Input Power
(50 Mhz, 25°C±5°C, 0 dB Reference)



Bridge Frequency Response:

Return loss measurements using the 8540 Series can be frequency compensted using the standard "Open /Short" supplied with the bridge.

Insertion Loss:

6.5 dB, nominal, from input port to test port.

Detector Polarity: Negative

Maximum Input Power: +27 dBm (0.5W)

Directional Bridge Accessories:

An Open/Short is included for establishing the 0 dB return loss reference during path calibration.

CHAPTER 2

INITIAL INSTRUCTIONS

RECEIVING INSPECTION

Inspect the instrument for shipping damage. Be sure that all portions of the shipment are located before discarding any packing material or shipping containers.

Items that should be included in the shipment are as follows:

1 ea	Model 8541 or 8542 Universal Power Meter
1 ea	Sensor Cable (Model 8541) or
2 ea	Sensor Cables (Model 8542)
1 ea	AC Power Cable
1 ea	Operating and Maintenance Manual

The serial and code numbers of the instrument are located on a label on the rear panel. The code number is a configuration designation which is updated for specific instruments as certain changes are incorporated. When calling your representative or the factory with questions relating to your instrument, always be sure to have the code number as well as the serial number at hand.

POWER REQUIREMENTS

WARNING: Before applying ac mains power to the instrument, be sure that the instrument is set for the correct line voltage.

The unit is set at the factory for operation at the normal supply voltage for the country in which it is sold. The input frequency must be 50 to 400 Hz ±5%. The combination of the module and transformer design allows instrument operation of 100/120/ 220/ 240 volts (uses 1A Fast-Blo fuse), with an average power consumption of 20VA.

Conversion from one voltage to another can be made by changing the voltage selection drum located inside the power input panel on the rear panel. This is done by pulling the power panel cover down using the tab located on top, and then pulling the small drum with the voltage indications straight out. Position the drum so that the desired voltage will show through the cut-out in the cover, and then push it straight in .

CHASSIS GROUNDING

DANGER: FAILURE TO PROPERLY GROUND THE INSTRUMENT CAN ALLOW HIGH VOLTAGES TO BUILD UP ON THE CHASSIS. THE VOLTAGE LEVELS COULD BE DANGEROUS TO OPERATING PERSONNEL.

The instrument is supplied with a three-conductor NEMA type power cord. For 110V operation, the neutral conductor is white and the hot wire is black. For 220V operation, both the white and black wires are hot.

The green wire of the power cord is for connection to earth ground. The instrument will be properly grounded if the plug is connected to a properly installed three-prong receptacle. If a three-prong to two-prong adapter is used, be sure that the pigtail lead of the adapter is earth-grounded.

PASSWORD PROTECTION

The Giga-tronics 8540 Series Power Meters are shipped from the factory with the password protection feature OFF. Password protection can be user activated to prevent unauthorized changes in the Cal Factor and Calibrator data stored in the EEPROMs in the instrument, and in the sensors used with the instrument.

It is strongly recommended that this password protection be implemented immediately to prevent any problems that could arise due to accidental or unintentional changes to the calibration data stored in the EEPROMs.

Please use the following procedure to activate the password protection: (Front panel keys shown in **BOLD**; front panel display selections shown in *italics*)

NOTE: Up/down and left/right "scrolling" is done by using the CURSOR keys (as described in #6 on page 3-7 of the OPERATION chapter).

1. Press **MENU** and scroll down to *SERVICE MENU* (at the bottom of the listing), and press **ENTER**.

2. Scroll to *CALIBRATOR* and press **ENTER**.

3. Select *EEPROM* and press **ENTER**.

4. At *SNumb*, press **ENTER**.

5. At *CALFAC*, either press **ENTER** to accept the value shown or enter a new value followed by **ENTER**.

6. At *DATE*, either press **ENTER** to accept the value shown or enter a new value followed by **ENTER**.

7. At *TIME*, either press **ENTER** to accept the value shown or enter a new value followed by **ENTER**.

8. Select *WRITE* and press **ENTER**.

9. Select *SET* and press **ENTER**.

10. Enter the desired password and press **ENTER**.

11. Press **ENTER** again to confirm the password. The data will then be written to the EEPROM.

Now the calibrator EEPROM data cannot be changed without entering the password.

The password can be cleared or changed by repeating Steps 1 through 8 and then entering the current password. At this point, you can set a new password by selecting *SET*, clear the password by selecting *CLEAR*, or just rewrite the data by selecting *ON*. In each case, follow the selection with **ENTER**.

If the password has been previously set and is not known, it can be bypassed by moving the A2W1 jumper on the Analog PC Board from the factory set position "B" to position "A". See the reference on performing this procedure given in paragraph A on page 7-2 of the MAINTENANCE chapter.

GPIB ADDRESS SELECTION

Before the instrument can be remotely controlled over the interface bus, it must be assigned a specific address (default address is 13) so that the controller can differentiate it from other active bus components. This is accomplished with the following keystrokes:

MENU —> (scroll to) *SETUP* (by pressing bottom Cursor key) —> **ENTER** —> (scroll to) *GPIB* —> **ENTER** —> Press left or right Cursor key to select GPIB mode or address, and use up or down Cursor key to set address or mode —> **ENTER**

ENVIRONMENTAL REQUIREMENTS

Temperature, humidity, and altitude requirements must be considered for accurate and reliable operation of the instrument. These are defined as:

Temperature:

Operating:	0 to +50°C (+32 to +122°F)
Storage:	-40 to +55°C (-40 to +131°F)

Relative Humidity: 95% maximum

Altitude: Up to 2500 meters (pressurized freight at 27kPa differential i.e. 3.9 lbf/in2)

SENSOR PRECAUTIONS

The 8540 Series Power Meter sensors are configured in a metal housing to provide superior mechanical performance as well as excellent shielding. When connecting the sensors to other devices or components it must be remembered that **THE BODY OF THE SENSOR SHOULD NEVER BE TURNED IN ORDER TO TIGHTEN THE RF CONNECTION**. Mechanical damage may result if improper handling is attempted when connecting the sensors. Scratched or damaged connector mating surfaces can lead to inaccurate measurements.

WARNING: All Giga-tronics power sensors contain balanced, zero biased Schottky diodes for power sensing. If the sensor is connected to CW or Peak power devices whose power output is in excess of +23 dBm (200 mW, which is the 100% average for standard and pulse sensors) degradation or total destruction of the diode can occur. Diodes degraded or destroyed in this manner will not be replaced under warranty. Destructive signal levels are higher for High Power, True RMS, and Low VSWR sensors.

RETURNING THE INSTRUMENT

If it is felt that the instrument should be returned to Giga-tronics for any reason, it is recommended that the Giga-tronics Customer Service Department be contacted before the unit is sent back. It is often the case that many problems can be resolved by telephone or Fax without the necessity of returning the instrument. The telephone number is (408) 734-5780, extension 267, or Fax 747-1265.

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PLEASE FOLD THIS SHEET OUT TO THE LEFT
AND START WITH THE TEXT ON PAGE 3-5.**

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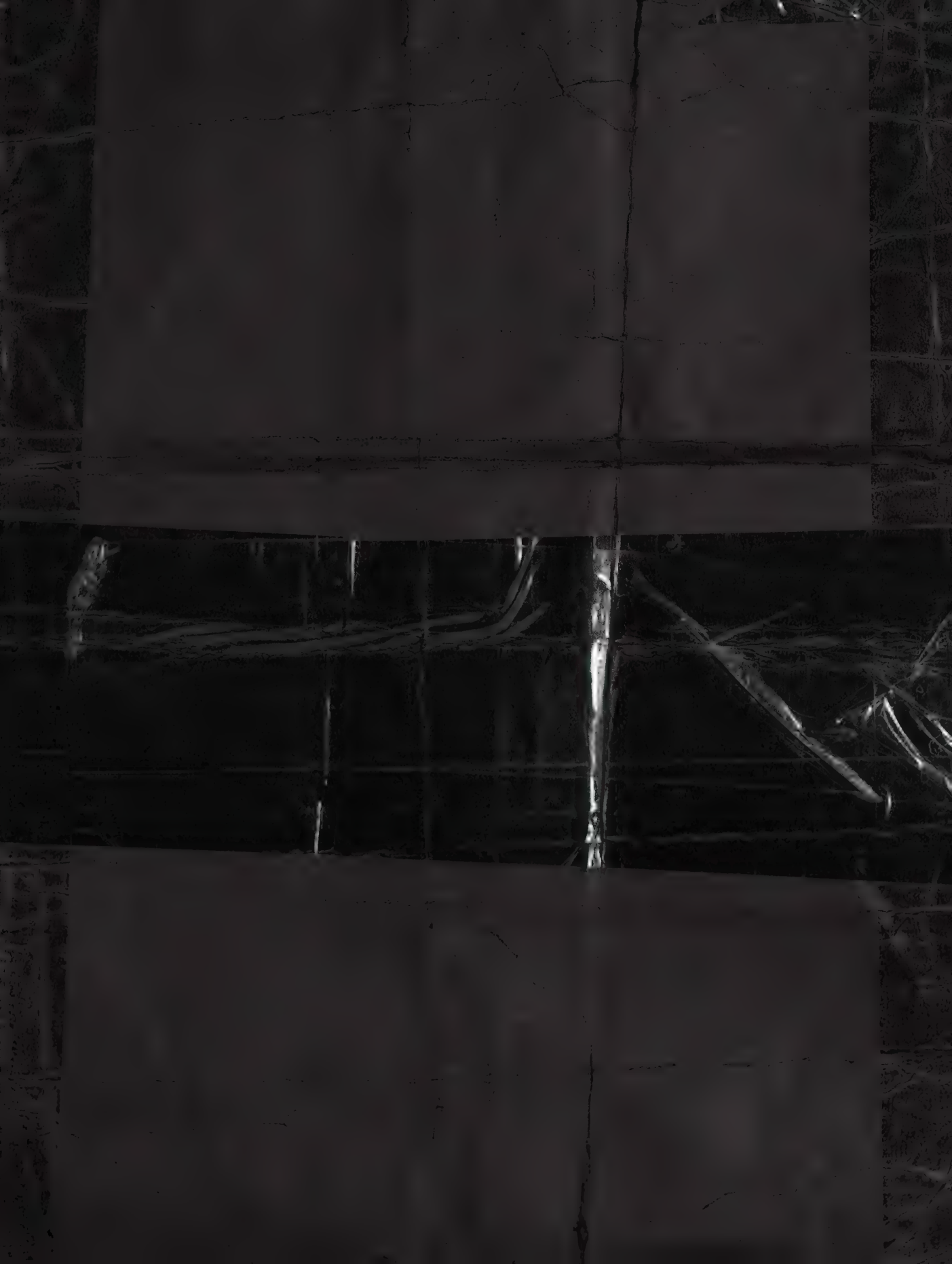
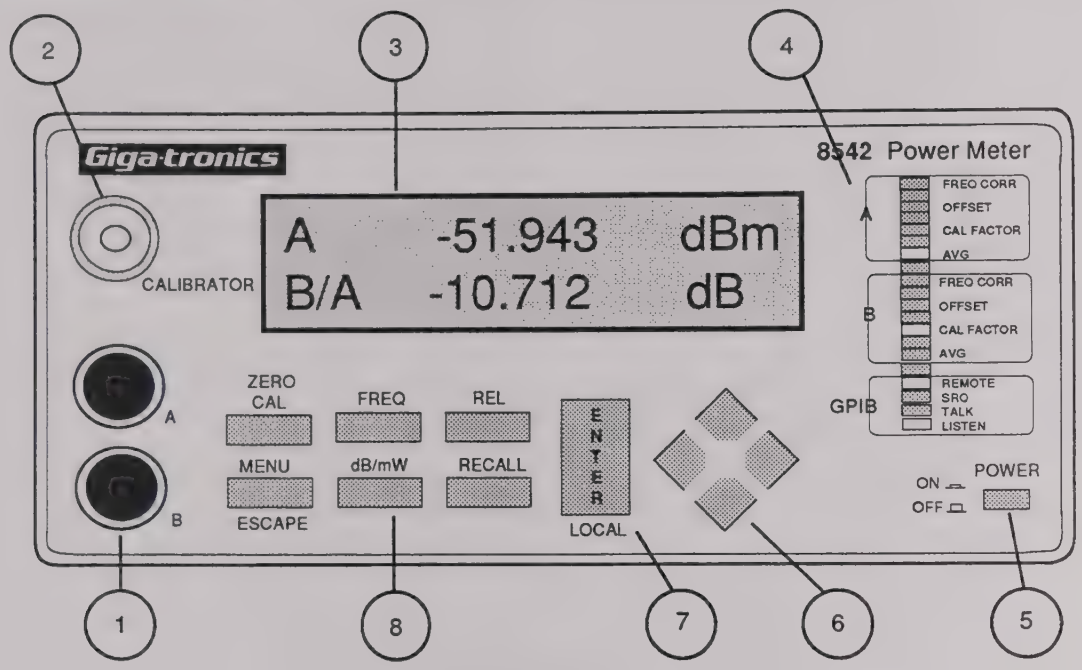
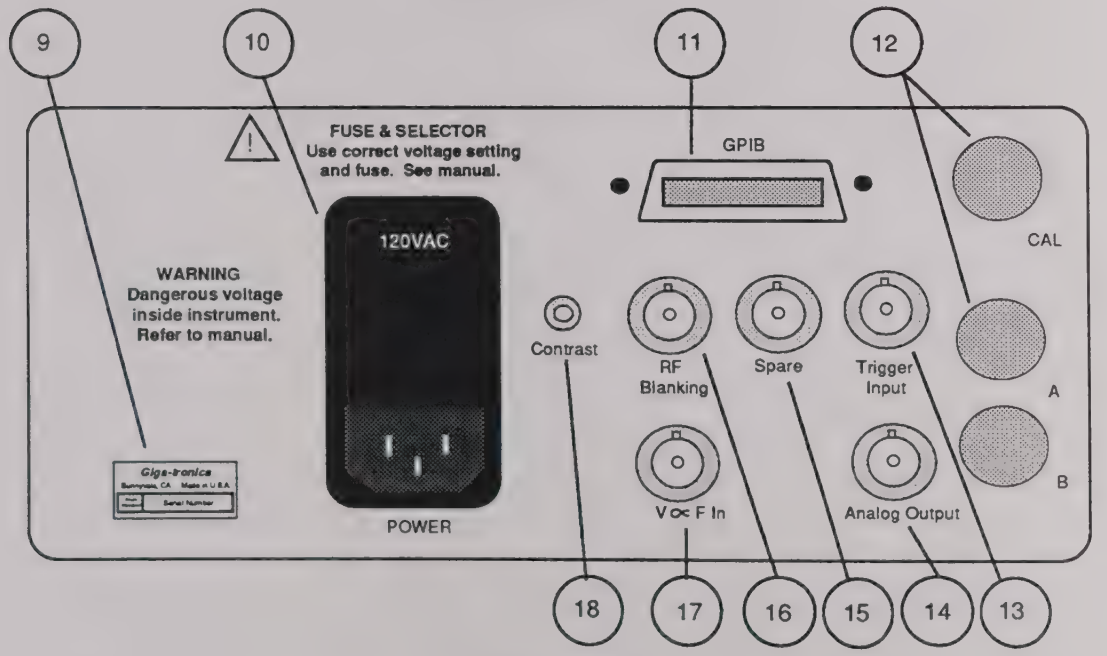




FRONT PANEL



REAR PANEL

Figure 3-1. Model 8542 Front and Rear Panel Components

[See the corresponding numbers on page 3-4 for names of components, and in the Instrument Front and Rear Panel Descriptions (next) section for component descriptions.]

8540 Series Power Meter Components Shown in Figure 3-1: (Description Location)

Front Panel

1) Sensor Inputs ..... (page 3-5)
2) Power Sweep Calibrator Output ..... (page 3-6)
3) LCD Display Screen ..... (page 3-6)
4) Configuration / Peaking Indicators ..... (page 3-6)
5) AC Power ON/OFF Switch ..... (page 3-7)
6) Cursor (up/down, left/right) Keys ..... (page 3-7)
7) ENTER Key ..... (page 3-7)
8) Configuration Keys ..... (page 3-7)

Rear Panel

9) Manufacturer's Identification (Serial/Code Number) Tag ..... (page 3-10)
10) AC Power Input and Fuse Holder ..... (page 3-10)
11) GPIB Interface Connection ..... (page 3-10)
12) Optional Connections for Calibrator Output and Sensor Inputs ..... (page 3-11)
13) Trigger Input ..... (page 3-11)
14) Analog Output ..... (page 3-11)
15) Spare ..... (page 3-12)
16) RF Blanking Output ..... (page 3-12)
17) V prop. F Input ..... (page 3-12)
18) Contrast Control ..... (page 3-12)

CHAPTER 3

OPERATION

Instrument Front and Rear Panel Component Descriptions

Introduction

This chapter consists of two sections describing (1) front and rear panel controls, and (2) menu selectable controls. The information applies to both the single channel 8541 and the dual channel 8542 instruments, except where noted.

The first section describes the controls, displays, and electrical connectors on the front and rear panels of the 8540 Series instruments. Please reference the numbers given below for the front and rear panel components to the numbers shown in Figure 3-1 on the fold-out sheet, page 3-3.

FRONT PANEL COMPONENTS

1. Sensor Inputs

The sensor input connections (located directly below the power sweep calibrator port) are used to connect the power sensor cable from the power sensors to the power meter's chassis. Option 03 is available if it is desired to connect the sensor input to the rear of the instrument.

NOTE: It is important to remember to exercise care when connecting the sensor cable to the power sensor or main chassis. The connector has many connector pins which can be damaged when misaligned under excessive force.

NOTE: Front panel hardkey designations will be shown in **BOLD**, and software display indications in *italics* in the following discussions.

2. Power Sweep Calibrator

The Power Sweep Calibrator is used to calibrate the amplitude response of the power sensors. Calibration is initiated by connecting a power sensor to the calibration port and pressing the **Zero/Cal** key on the front panel. The calibrator will automatically zero the sensor and perform the amplitude output response calibration. See "**Zero/Cal**" key description on page 3-8 for additional information.

3. Display Screen

A two line display provides a versatile interface for simultaneous viewing of one of the following: both channels (A and B), a single channel and a ratio of two channels, or simultaneous dB and mW display of a single channel.

The backlit LCD display is easily viewed over a wide angle range. If necessary, the contrast can be adjusted with the small knob near the center of the rear panel.

4. Configuration / Peaking Indicators

The LED indicators on the right side of the power meter are used to provide either measurement channel configuration data, or a decade range peaking meter.

Configurations of the measurement channels are easily checked with the LED indicators. The LED indicators are illuminated whenever one of the following functions is active:

1. Frequency response correction.
2. Measurement level offsets.
3. Manual calibration factors.
4. Manual Averaging.

See the "Peaking Meter" discussion on page 3-17 for a description of how the LED indicators also operate as a peaking meter.

5. AC Power ON/OFF Switch

Actuation of the **Power** On/Off Switch applies ac mains power to the meter. The ON condition is indicated by illumination of the backlit display screen.

See Chapter 2, Initial Instructions, prior to applying ac mains power to the 8540 Series meter. Follow the instructions for fuse selection and operating voltage.

6. Cursor Keys

Four **Cursor** keys are used to control menu selections and change configuration parameters. Upon actuation of the **MENU** key, the cursors are used to display the desired menu selection. After the menu selection is identified, the cursors are used to adjust the selection parameter.

7. ENTER Key

Pressing the **ENTER** key enters the selected configuration parameter into the current configuration of the 8540 Series Power Meter. The **ENTER** key is also used to perform menu selections.

Note the LOCAL indication printed below the **ENTER** key. During remote GPIB control, the **ENTER** (LOCAL) key returns the 8540 Series meter to local, front panel operation. Under remote operation, the Configuration Keys will not operate until the **ENTER** (LOCAL) key is pressed. This key can be disabled under GPIB control with the "Local Lockout" command.

8. Configuration Keys

The six Configuration Keys shown in Figure 3-2 on the next page allow front panel setup of the 8540 Series Meters. These keys include ZERO/CAL, FREQ, REL, MENU (ESCAPE), dB/mW, and RECALL, and will be described in the text to follow.

Every selection available with the Configuration Keys - including all menu operations - is also available via the IEEE 488 compatible GPIB interface.

Figure 3-2. Configuration Keys for Selection of 8540 Series Control Settings.

ZERO/CAL Key

The **ZERO/CAL** key will automatically zero or calibrate the power sensors. To calibrate the power level response of the sensor, connect the sensor to the built-in Power Sweep Calibrator and press the **ZERO/CAL** key. The 8540 Series meter will automatically calibrate the sensor's input/output response, and store the amplitude correction in digital memory.

When the sensor is disconnected from the Power Sweep Calibrator, pressing the **ZERO/CAL** key will automatically zero the sensor. It is best to connect the sensor to the DUT (Device Under Test) or measurement port during the zeroing process. By turning off the RF power instead of leaving the detector disconnected, the zeroing process automatically accounts for measurement line noise, ground potential descrepancies, and connector interface emfs. These effects have a significant impact on measurement accuracy at low power levels - generally in the lower 15 dB of a sensor's dynamic range.

FREQ Key

The **FREQ** key allows numerical entry of the desired measurement frequency. Microwave power sensors have a measureable frequency response; that is, the detector produces slight variations in input/output response with frequency. To compensate for this effect, frequency calibration factors (Cal Factors) have been stored in an EEPROM contained within the sensor housing. Entering the frequency of operation allows the 8541/2 to automatically correct the measurement with the appropriate Cal Factor.

If manual entry becomes overly repetitious or cumbersome, the operating frequency can be entered via GPIB or by connecting the V prop F output on the signal source to the V prop F input on the 8541/2 meter.

REL Key

The **REL** key is used for relative measurements. To set a reference level, press the **REL** key. Subsequent power measurements are displayed relative to the reference level. To disable relative measurement operation, press the **REL** key a second time.

Simultaneous display of signal power and relative power is useful for measurements such as single frequency 1 dB compression. The 8542 meter's default configuration displays relative levels on both channels when the **REL** key is actuated. To disable relative measurement on one or both channels, select *REL SETUP* from the SETUP Menu.

MENU (ESCAPE) Key

The 8540 Series Power Meters' configuration menu is accessed by pressing the **MENU** key. Menu selections and parameter entries are made using the **Cursor** keys and the **ENTER** key.

Note the ESCAPE indication printed below the **MENU** key. Pressing the **MENU** (ESCAPE) key allows exit from the menu tree without changing a menu selection

dBm/mW Key

The **dB/mW** key changes measurement units of the displayed power level values. To change the display units from dBm to mW, press the **dBm/mW** key. Actuate the **dBm/mW** key again to return to dBm units. The 8540 Series meter's default configuration displays dBm units on both channels.

Simultaneous display of signal power in dBm and mW can be configured by selecting *dB/mW SETUP* from the SETUP Menu.

RECALL Key

The **RECALL** key permits selection of pre-configured instrument settings including a preset default configuration, displayed as *Preset*; up to 20 saved configurations, available in memory registors - *Reg#* - 1 through 20; and previous configuration, stored as *Reg# 0*. Use the left/right **Cursor** keys to select *Preset* or *Reg#* and the up/down **Cursor** keys to select the appropriate register number.

The *Preset* selection reconfigures the instrument to the 8540 Series meter's default settings. Selecting *Preset* does not erase the calibration of the sensors; only the instrument configuration is

altered. This function is useful during ATE system programming as a means of returning the instrument to a known starting condition.

Instrument configurations are recalled by their *SAVE SETUP* memory registor number, *Reg#*. 20 saved instrument configurations may be seaved in registers 1 through 20.

The 8540 Series Power Meter's previous configuration (configuration just previous to the last recall operation) is stored in *Reg# 0*.

NOTE: To save an instrument setting, select SAVE SETUP from the Setup Menu. Then use the up/down Cursor keys to select one of the memory locations - numbered 1 through 20.

REAR PANEL COMPONENTS

9. Serial/Code Number Tag

The Serial Number and Code (Configuration Reference Level Designation) Level of the instrument are located on the Manufacturer's Identification Tag. The code level of the Operating & Maintenance Manual supplied with the instrument is shown in the lower right corner of the Title Page of the manual. Compare this number to the Code number shown on the Identification Tag. If the code level of the particular instrument is higher, the Manual Corrections section at the back of the manual should be consulted for the necessary corrections required in the manual to make it conform to the specific 8541/2 instrument.

10. AC POWER Input and Fuse Holder

The ac mains power input receptacle is compatible with the supplied power cable. Check page 2-1, Chapter 2, Power Requirements, for voltage, frequency, and fuse requirements prior to applying ac power to the instrument.

11. GPIB Connection (IEEE-488 Compatible)

This is the interface connection for remotely controlling the instrument through the GPIB. The default GPIB address is 13.

12. Rear Panel Inputs (Optional location for Calibrator Output and Channel Inputs)

The Power Sweep Calibrator output and the channel A and B inputs (channel A only on the 8541) will be blank plates unless Option 03 (Rear Panel connection) has been specified. With Option 03 the channel inputs and calibrator output will not be present on the front panel and will, instead, be located here.

13. Trigger Input

The Trigger Input is a TTL input for triggering the high speed power measurements under GPIB control. Using the "Burst TTL Trigger" mode, a single trigger will fill the data buffer with measurement data which is then transmitted over the GPIB - allowing in excess of 2000 readings per second.

Triggering for high speed, buffered, power measurements can also be accomplished via the GPIB. See page 4-5 in the IEEE BUS INTERFACE chapter.

14. Analog Output

The Analog Output provides a voltage proportional to Power level output from a DAC inside the 8540 Series Power Meter. One Analog Output is standard with both the 8541 and the 8542. A second Analog Output is added with Option 06, but is only available with the dual channel 8542. The analog output signal can be specified as either the top line or the bottom line on the display.

The voltage level of the Analog Output is configured from 0.0V to 10.0V to adjust for display and test setup characteristics.

NOTE: Using OFFSET or USER CAL FACTOR will affect both the displayed power level and the Analog Output voltage level.

15. Spare

Option 06 configures the 8542 Power Meter Spare connector as a high speed analog output. Other options may be available with the Spare connector. Please consult the Giga-tronics Power Measurements Division for configuration options. Otherwise, the Spare connection is not operable.

16. RF Blanking

The RF Blanking connection provides a normally low 0.0V TTL output which is used to power off a microwave test signal source while zeroing a power sensor. The voltage level is 5.0V during the time when either sensor A or B is zeroing. This capability is convenient for many ATE systems; the signal source is automatically disabled while the power sensor is zeroed.

CAUTION: *RF Blanking is* ***not*** *a method of sensor protection. Never apply excessive input power to a microwave power sensor. Severe damage to the detector elements will result. See sensor specifications on page 1-6 of Chapter 1 for power level limits.*

17. V prop. F In

The V prop. F In connector can be connected to the V prop. F output of signal sources so that the measurement frequency is automatically determined by the power meter. This input is especially useful under swept measurement conditions.

Microwave power sensors have a measureable frequency response. That is, the detector produces slight variations in input/output response with frequency. For this reason, the frequency of operation should be entered when performing measurements.

Alternately, the operating frequency can be entered via GPIB or from the front panel.

18. Contrast

This control adjusts the contrast of the backlit LCD display.

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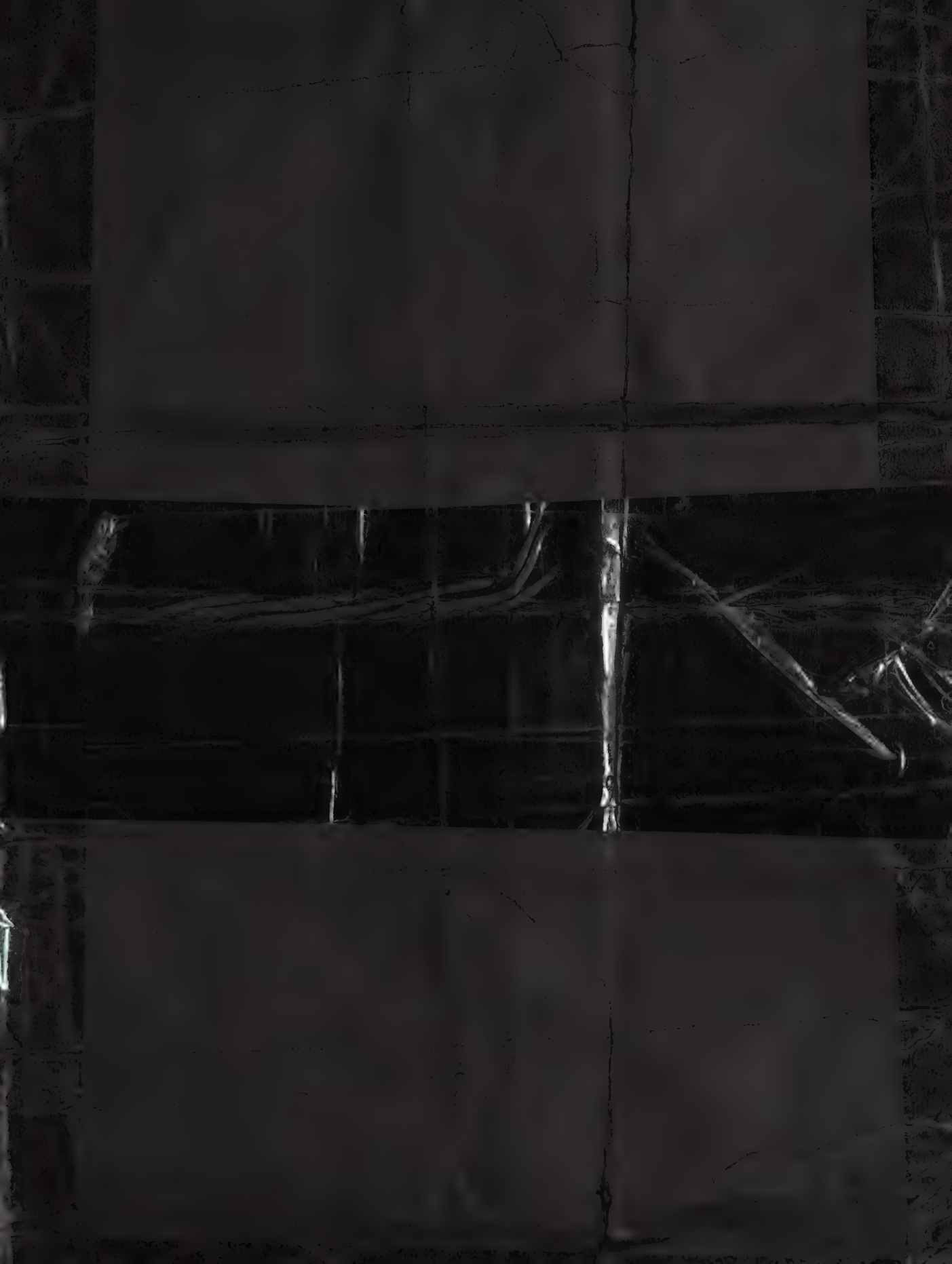

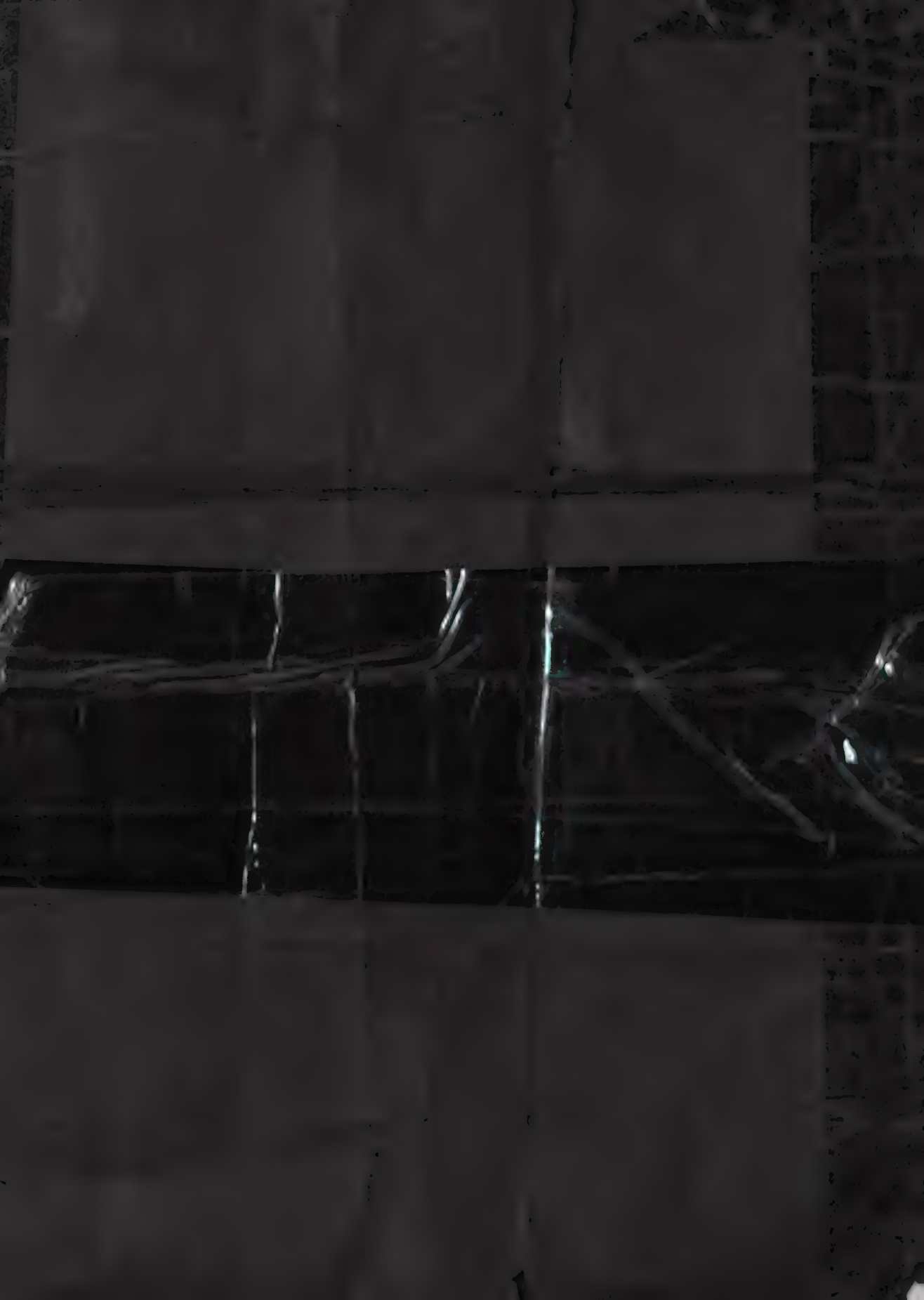

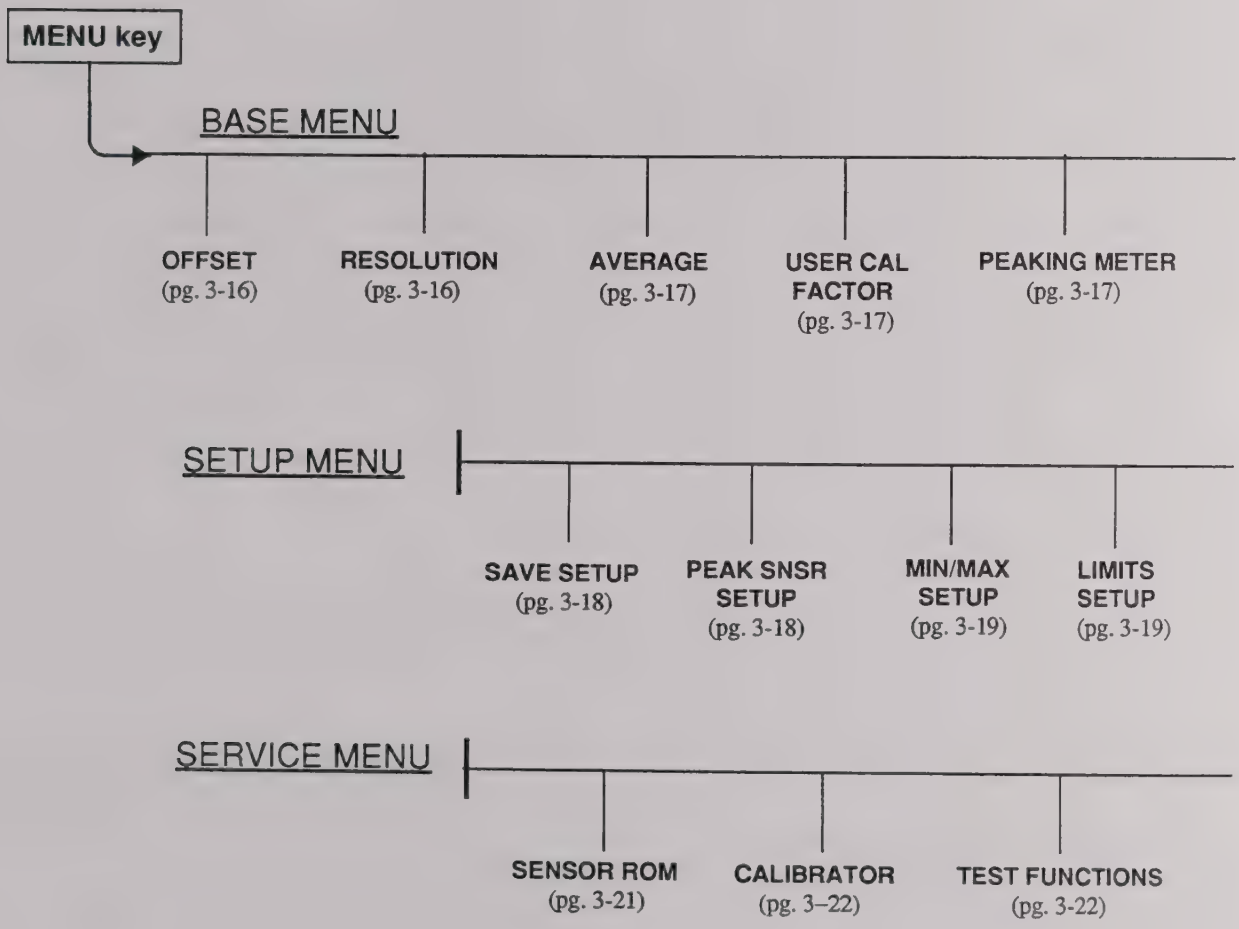

Figure 3-3. 8540 Series Menu Selection Index
(with page reference for description of function)

MENU DESCRIPTIONS

MENU TREE

(MENU key)

The Menu Tree is accessed from the front panel with the **MENU** key. As shown in Figure 3-3 the the Menu Tree is divided into three sections; the Base Menu, the Setup Menu, and the Service Menu. The Base Menu contains the most commonly used menu features such as averaging.

Each of the menus have memory capability; that is, upon exiting the Menu Tree, the 8540 Series (8541/2) remembers the previous menu selection. Subsequent actuation of the **MENU** key will return the instrument to the previous Base Menu selection. Similarly, the Setup and Service Menus remember previous menu selections.

The Base Menu

The Base Menu is the first level of menu selections after the **MENU** key is actuated. Direct selections include *OFFSET, RESOLUTION, AVERAGE, USER CAL FACTOR, PEAKING METER, REF POWER ON/OFF, A/B, ... ,OFF, SETUP MENU*, and *SERVICE MENU*. To display the contents of any menu item, press **ENTER**.

Pressing the **ENTER** key with *SETUP MENU* or *SERVICE MENU* displayed allows access to those menus.

OFFSET

Offset range is from -99.99 dB to 99.99 dB. Offsets for sensor A or sensor B are independent. Select *Sensor A* or *Sensor B* with the up/down **Cursor** keys, press **ENTER**, and adjust the desired value with the **Cursor** keys. Press **ENTER** to activate the offset value. To exit the menu without entering the offset press the **MENU (ESCAPE)** key.

RESOLUTION

The display resolution of the top line and the bottom line are independently selectable. Logarithmic (dBm, dBr, and dB) display resolution is selectable from zero to three digits to the right of the decimal point. Use the left/right **Cursor** keys for resolution selection. When the Linear units mode is in use, the display resolution is selectable from one to five significant figures.

AVERAGE

Successive measurements can be automatically averaged. Upon activation of this selection (press the **ENTER** key) averaging values of 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, and *AUTO* can be specified for sensor A and/or sensor B using the left/right **Cursor** keys. Select *Avg. Sensor A* or *Avg. Sensor B* with the up/down **Cursor** keys.

NOTE: Averaging affects measurement speed.

AUTO Averaging, the default setting, automatically adjusts the amount of averaging according to the level of ambient noise. As the power level approaches the noise floor of the sensor or return loss bridge, the 8541/2 automatically increases averaging to stabilize the display. AUTO Averaging is optimized for front panel control; when additional averaging is needed, select an averaging value such as 64 or 128.

USER CAL FACTOR

This selection enters a user supplied calibration factor which is automatically added to measurement values. The entered value, which has a range of -9.99 dB to +9.99 dB is automatically added to the measurement value. The User Cal Factor should not be confused with the power sensor's Frequency Calibration Factors, commonly refered to as Cal Factors, which are stored on an EEPROM within the sensor housing. Using *USER CAL FACTOR* disables all automatic corrections for the Frequency Calibration Factors until the operating frequency is changed via the front panel or over the GPIB.

User Cal Factors are used to compensate for mismatch losses and other small variations such as adapters or cables in the measurement path. For automatic display correction due to couplers, attenuators or amplifiers, *OFFSET* should be used.

PEAKING METER

The yellow Light Emitting Diodes (LEDs) on the right side of the 8541/2 front panel perform two mutually exclusive functions: Status Indicator or Peaking Meter. The peaking meter function is a convenient visual indicator for tuning DUT (Device Under Test) power levels to a maximum or minimum. The peaking meter's 20 segment LED bar graph covers single decade bands with a linear scale.

Select *Peaking Meter* from the SETUP Menu and press ENTER. Use the up/down Cursor keys to select *Peaking*. The peaking meter provides a bar graph representation of output power. For good display resolution while tuning or peaking, the bottom to full scale response adjusts on a decade range basis. A wrap around feature provides coverage over the full dynamic range of the meter.

REF POWER ON/OFF

Selecing *REF POWER ON/OFF* will cause the Power Sweep Calibrator to output 0.00 dBm. This command is used to turn on or off that capability. ***The Calibrator should always be turned OFF when not in use.***

(NOTE: The REF POWER value is only stable for 15 seconds. It will then start to slowly drift.)

A,B,A/B,...,OFF

This selection defines the display format for the top line and bottom line of the dual line, backlite LCD display. Use the up/down **Cursor** keys to manipulate the top or bottom lines and the right/left **Cursor** keys to select *A*, *B*, *A/B*, *B/A*, *A-B*, *or B-A*.

SETUP MENU

The Setup Menu is selected from the Base Menu after the **MENU** key is actuated. Direct selections include *SAVE SETUP*, *PEAK SNSR SETUP*, *MIN/MAX SETUP*, *LIMITS SETUP*, *dB/mW SETUP*, *REL SETUP*, *GPIB SETUP*, *ANALOG OUT SETUP*, *VpropF SETUP* and *SOUND SETUP*. To display the contents of any menu item, press **ENTER.**

SAVE SETUP

Up to twenty different configurations can be stored in nonvolatile memory. When *SAVE SETUP* is selected the display will present a prompt to enter the number under which the current configuration will be stored. Entry is completed by pressing **ENTER.**

PEAK SNSR SETUP

Peak Power Sensors can be triggered either internally, externally, or used in the CW mode. The trigger point to sample point delay (sample delay) is adjustable from 0.5 ns to 100 ms. The *PEAK SNSR SETUP* selection allows these parameters to be specified from the 8540 Series front panel.

Using the 80350A Series Peak Power Sensors

80340 SERIES TRIGGERABLE PULSE SENSORS

The 80340 Series Sensors will operate satisfactorily with the 8541/2 Power Meters, but they do not have the easily adjustable sample delay feature of the 80530A Series Peak Power Sensors (the 80340 Series sample delay must be set by a potentiometer within the sensor). Also, the 80340 Series have no trigger level setting (must have multiple pulses to be able to trigger) as is contained in the 80350A Sensors.

The 80350A Series Peak Power Sensors are configured with the 8541/2 Power Meter as shown in Figure 3-5, below.

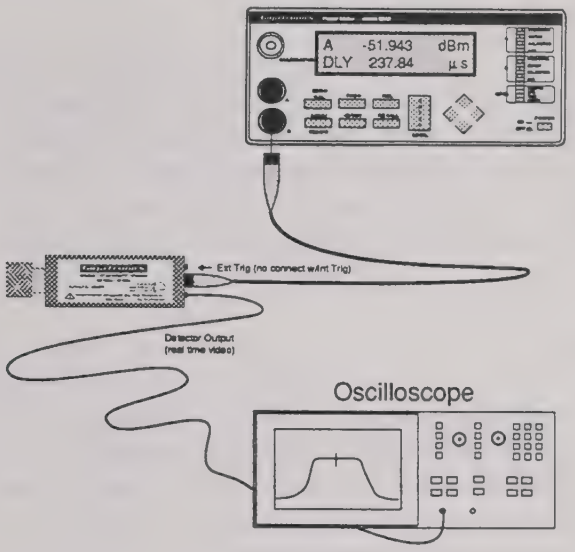

Figure 3-5. Peak Power Sensor System Configuration

Access from the front panel of the 8541/2 to control the Peak Power Sensor is accomplished using the menus as shown on the Main Menu Tree (Figure 3-4 on page 3-15).

First access the **SETUP MENU** by pressing **MENU** —> *SETUP MENU*, and then:

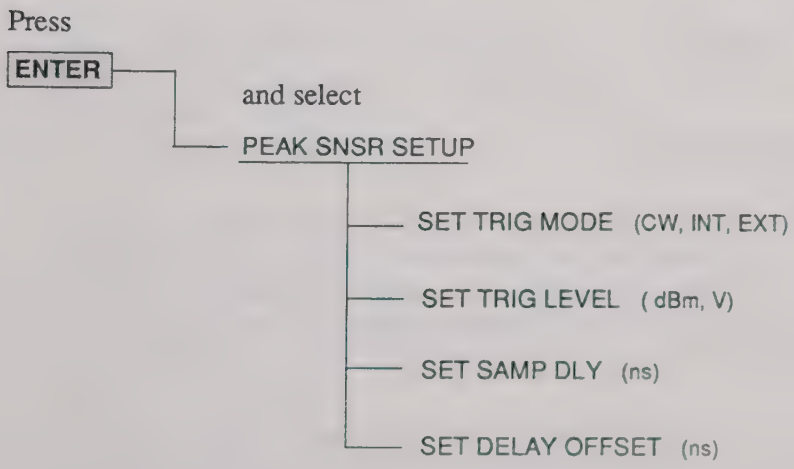

Figure 3-6. Peak Power Sensor Menu Tree Access

Complete information on the use of the 80350A Series Peak Power Sensors can be obtained from the 80350A Series Peak Power Sensor Operating and Maintenance Manual that came with the sensor(s).

MIN/MAX SETUP

The *MIN/MAX SETUP* selection allows the maximum and minimum measurement values to be displayed on the front panel. Select *TOPLINE* or *BOTTOM LINE* as the channel to be monitored. Both min. and max. will be displayed on the other line. To reset min and max monitoring, select *MIN/MAX SETUP* and press **ENTER** twice.

LIMITS SETUP

High and Low limits can be separately defined for each channel. As long as sound is enabled (default is enabled), an audible tone is generated during a limit line violation. High Limit violations are indicated on the front panel with an "up" arrow. Low Limit violations are indicated with a "down" arrow.

dB/mW SETUP

dB/mW SETUP allows separate logarithmic or linear configuration of the top line and bottom line. By selecting *LOG* for the top line and *LIN* for the bottom line (with both display lines measuring one channel) absolute power is simultaneously displayed in both dBm and mW units. For ratio measurements (A/B or B/A), logarithmic and linear units are **dBr** and **%r** respectively.

The **dB/mW** key on the 8540 Series front panel toggles the display lines between logarithmic and linear units.

REL SETUP

The *REL SETUP* selection can disable relative measurements on one or both of the two display lines. After selecting *REL SETUP*, use the right/left **Cursor** keys to select *ON* or *OFF*. Selecting *OFF* for both lines effectively disables the ability to perform relative measurements with the **REL** key.

The Relative measurements are convenient during 1 dB compression measurements. The gain display channel (A/B or B/A) should have relative enabled, while the output channel (A or B, respectively) should display absolute output power.

The default 8540 Series configuration enables relative measurements on both the top and bottom lines when the **REL** key is pressed.

GPIB SETUP

The *GPIB SETUP* selection allows entry of a GPIB address for the IEEE 488.1 compatible interface. The default address is 13. Changes to the GPIB address must be performed from the 8541/2 front panel. Address changes are not operable via the GPIB interface.

ANALOG OUT SETUP

The *ANALOG OUT SETUP* produces a voltage proportional to Power level for use with data loggers, strip chart recorders or other data acquisition products. There are two user selectable modes, Log and Linear. Each have a user definable operation range; however, the 8540 Series will not output levels less than 0.0V or greater than 10.0V.

In Log Mode, the 0.0V to 10.0V output corresponds to the -80 dBm to +20 dBm power levels (default)

In the Linear Mode the 0.0V to 10.0V output corresponds to each decade range of measurement power, similarly to most CW power meters. The voltage level of the Analog Output is configured from 0.0V to 10.0V to allow for the adjustment of display and test setup characteristics. If 0.00V reference levels are desired at positions other than decade crossings, Offsets can be used to effectively shift the reference level.

While each 8541/2 Power Meter has a connector labeled **Spare**, it is not operable without special factory configuration. Option 06 configures the **Spare** connection as a high speed Analog Output.

V propF SETUP

The **VpropF** input connector is a convenient method for the 8541/2 Power Meter to determine the operating frequency of the signal and automatically compensate for any sensor frequency response variations with the sensors Cal Factors. Most signal sources are equipped with an external V/GHz output which can be connected to the **VpropF** input connector with a BNC cable.

The VpropF input ADC can only "read" voltages between 0.0V and 10.0V. This voltage range is common to most sources. To activate this input as the source of sensor Calibration Factor correction, select VpropF under the *SETUP MENU*, press the **ENTER** key, and select *ON* using the up/down Cursor keys. To set the start voltage and scale the ADC input to your sources output voltages, select the source frequency that corresponds to a 0.0V output from your source and enter that frequency value. Set the V/GHz Scale Factor: this is usually printed on the back of the source.

SOUND SETUP

Audible tones and clicks are produced by a small speaker within the Digital Power Meter's chassis. The tones indicate completion of operations such as zeroing or calibration and limit line violations. The clicks are used for front panel key actuations.

SERVICE MENU

The Service Menu is selected from the base menu after the **MENU** key is actuated. Direct selections include *SENSOR ROM*, *CALIBRATOR*, *TEST FUNCTIONS*, *SOFTWARE VERSION*, and *CLEAR ALL MEMORY*. To display the contents of any menu item, press **ENTER**.

SENSOR ROM

An EEPROM within the power sensor housing contains the frequency and corresponding frequency calibration factors which are precisely measured and loaded into the EEPROM. The *SENSOR ROM* selection is used to either view or change the calibration data for the power sensors and/or bridges connected to the 8540 Series Power Meter. Typical Cal Factor data is shown in Table 3-A, below. Use the up/down Cursor keys to scroll EEPROM data.

CALIBRATOR

The built-in Power Sweep Calibrator produces 51 discrete power levels from -30 dBm to +20 dBm. The output signal is 50 MHz, CW. The 0 dBm reference is traceable to a primary calibration standard at the NIST (National Institute of Standards Technology). With the *CALIBRATOR* selection, the calibrator's output level may be specified and switched *ON*. Output level can be specified in 1 dB increments from -30 dBm to +20 dBm.

Table 3-A. Typical Sensor EEPROM data.

Frequency (GHz)	Calibration Factor
0.05	0.00
1.0	-0.01
2.0	-0.02
3.0	-0.02
4.0	0.03
•	•
•	•
39.0	0.16
40.0	0.22

NOTE: The calibrator outputs will only be accurately set after doing a sensor calibration. With the exception of the 0.0 dBm setting, the output levels are not guaranteed.

TEST FUNCTIONS

A comprehensive set of self test functions is available from the front panel of the 8540 Series Power Meter. The self tests are accessed by selecting *TEST FUNCTIONS* under the SERVICE MENU . The self tests cover approximately 95% of the 8540 Series instruments functionality.

The user selectible tests include functional tests for the LED Display Tests, LCD Display Tests, Keyboard Test, Sound Test, RAM test, ROM Checksum Test, DAC functional Tests, Hardware Performance Tests, and analog to digital tests.

SOFTWARE VERSION

The 8541/2 software version can be verified under this selection

CLEAR ALL MEMORY

NOTE: If a password has been selected, the user will be prompted to enter it before *CLEAR ALL MEMORY* can be implemented. (See PASSWORD PROTECTION on page 2-2.)

Selecting *CLEAR ALL MEMORY* will clear **all** of the instrument's RAM memory and perform a "PRESET" returning the 8541/2 to its default configuration. While this will not affect the Cal Factors

stored within the power sensor's EEPROMs, the amplitude calibration data performed by the Power Sweep Calibrator will be erased. To clear instrument configuration parameters to default settings without erasing the amplitude calibration data, use the *PRESET* selection.

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CHAPTER 4

IEEE BUS INTERFACE

Introduction to GPIB Programming

GENERAL

The Giga-tronics 8540 Series Power Meters use standard protocols for communication over the GPIB bus. Commands adhear to the IEEE-488.1 or IEEE-488.2 guidelines. A complete alphabetical listing of commands appears starting on page 4-53.

Three emulation modes (436, 437, and 438) are available for users of older power meters who cannot re-write their application software.

The examples shown in this chapter will be written in HTBasic™ format. Different languages will use different commands, but the string sent or received will always be the same. In HTBasic, the OUTPUT command sends a string to the GPIB bus. The number after the word "OUTPUT" is the GPIB address of the instrument. In this case (713), the GPIB interface is assumed to be 7 and the instrument's address would be 13.

Changing the GPIB Mode or Address

Changing the GPIB operating mode or address must be done via the front panel. Enter the menu system with the **MENU** key. Select the *SETUP* menu using the up/down arrow keys. **ENTER** this sub menu system and select the *GPIB* setup menu key. Here the operating mode and GPIB address can be set with the arrow keys. Press **ENTER** to save your selection, or press **ESCAPE** (the menu key) to exit without saving.

13 is the factory-set default address of the 8540 Series meters. The GPIB address can be set from the front panel to any number from 0 to 30. GPIB address 40 will set the instrument to the listen only mode. Address 50 sets the instrument to the talk only mode.

™ HTBasic is a trademank of TransEra Corporation.

Power On Default Conditions

- GPIB Local Mode
- Unaddressed, Service Request Mask Cleared
- Status Byte Cleared
- TR3 Free Run Trigger Mode Set
- GT2 Group Execute Trigger Mode Set
- Parallel Poll Data Line Unassigned
- Display Enabled
- Service Request Mask Cleared
- Event Status Register = 128
- Event Status Mask Clear

ANALOG OUTPUT FUNCTION

PRELIMINARY - THIS FUNCTION STILL IN PROCESS

CONFIGURE ANALOG PORT A:

```
ANALOG MODE1 1, 1, -80.0, 20.0, 0.0, 10.0
```

Port A
Channel 1
Log Unit
Upper Voltage Limit (V)
Lower Voltage Limit (V)
Upper Power Limit (dBm)
Lower Power Limit (dBm)

ENABLE ANALOG PORT A OUTPUT:

```
ANALOG1 STATE ON
```

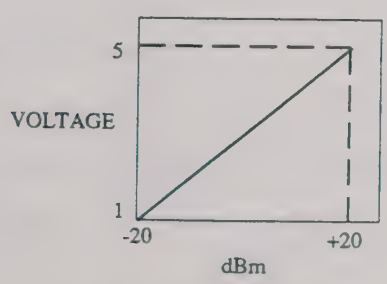
CONFIGURE ANALOG PORT B:

```
ANALOG MODE2 2, 2, 5000.0, 0.0, -10.0, 10.0
```

Port B
Channel 2
Linear Unit
Upper Voltage Limit (V)
Lower Voltage Limit (V)
Lower Power Limit (μW)
Upper Power Limit (μW)

DISABLE ANALOG PORT B OUTPUT:

```
ANALOG2 STATE OFF
```



PRELIMINARY - THIS FUNCTION STILL IN PROCESS

BURST MEASUREMENT MODE

OUTPUT 713;"BURST OFF" ! cancel burst mode
OUTPUT 713;"BURST POST GET BUFFER 200"

The chart below shows the elements of the burst mode command. The first word is "BURST". The next word specifies whether the burst of reading should occur before the trigger is sent ("PRE"), or after the trigger is sent ("POST"). The next word specifies a GPIB group execute trigger or a TTL trigger will be used. The next word sets the number of readings to take, and the last word sets the reading to reading delay time in milliseconds.

This command string tells the instrument to wait for a group execute trigger, and then take 200 readings. Since the time was not included, zero milliseconds is assumed and the instrument will take the readings as fast as possible. After the trigger, an "ENTER" statement can be used to read the data.

example: **OUTPUT 713;"BURST PRE TTL BUFFER 100 TIME 2"**

This command string tells the instrument to start taking readings every two milliseconds. After 200 milliseconds the buffer will be full and the instrument will start updating the buffer in a wrap around style. When the TTL trigger occurs, the instrument will stop taking readings and the buffer will be available for reading.

During burst mode the display is disabled. This is done to speed up the measurement process. The message "BURST MODE ON" will be displayed.

Command String Parameters

BURST	POST	GET	BUFFER	1 (thru) 5000	TIME	0 (thru) 5000
	PRE	TTL				
	OFF					
	DUMP					

example: OUTPUT 713;"BURST POST GET BUFFER 200"

CALIBRATION

```
OUTPUT 713;"AECL100EN"      ! Calibrate sensor A
OUTPUT 713;"BECL100EN"      ! Calibrate sensor B
```

The number "100" is a cal factor in units of percent. This number needs to be entered for other meters, but is not needed for the Giga-tronics instrument since the 8540 Series sensors have the cal factor stored in a non-volatile ROM in the sensor. The 8540 Series meter can read these numbers via a serial data transmission between the sensor and the meter. For program compatibility, the meter retains the use of a number. You may use any number between 50 and 120. The number you enter will be ignored, and the actual cal factors will be read from the sensor.

The proper sensor must be attached to the calibrator output for this command to operate correctly. If the sensor is not attached, the calibration will fail and be ignored.

```
Calibrate:                          ! calibration routine
ON INTR 7 GOSUB Srq_interrupt       ! setup serial poll interrupt
                                    ! jump location
ENABLE INTR 7;2                     ! enable SRQ interrupts
OUTPUT 713;"*SRE002"                ! set service request mask
                                    ! to 2
OUTPUT 713;"CS"                     ! clear status byte
OUTPUT 713;"CL100EN"                ! start calibration
Flag=0                              ! reset control flag
WHILE Flag=0                        ! wait while calibrating
END WHILE
RETURN

Srq_interrupt:                      ! SRQ interrupts jump here
OUTPUT 713;"*STB?"
ENTER 713;State
IF BIT(State, 1) THEN
   PRINT "GOOD CAL"
   ELSE
      IF BIT(State, 3) THEN
         PRINT "BAD CAL"
         ENDIF
ENDIF
OUTPUT 713;"CS"                     ! clear status byte
Flag=1                              ! set control flag true
RETURN
```

CAL FACTOR

Calibration factors are automatically entered by reading the EEPROM data in the sensor EEPROM. This is done everytime a sensor is attached to the power meter. The user can then enter the operating frequency manually via the "FREQ" key on the front panel, or use the GPIB command "FR". The power meter will use the correct cal factor for that frequency. If an additional cal factor is needed, then the cal factor command can be used.

```
OUTPUT 713;"AEKB99EN"   ! enter 99% cal factor to sensor A
OUTPUT 713;"BEKB99EN"   ! enter 99% cal factor to sensor B
```

The cal factor can be a number from 1.0% to 150.0%. This cal factor replaces any frequency correction cal factors currently being used.

CLEAR

CLEAR 713 ! send a device clear

The GPIB is reset and the instrument is set to the preset condition.

INTERFACE CLEAR

ABORT 7 ! send interface clear

This command resets the GPIB bus. It does not preset the instrument. The instrument will be un-addressed after the abort.

DATA OUTPUT FORMAT

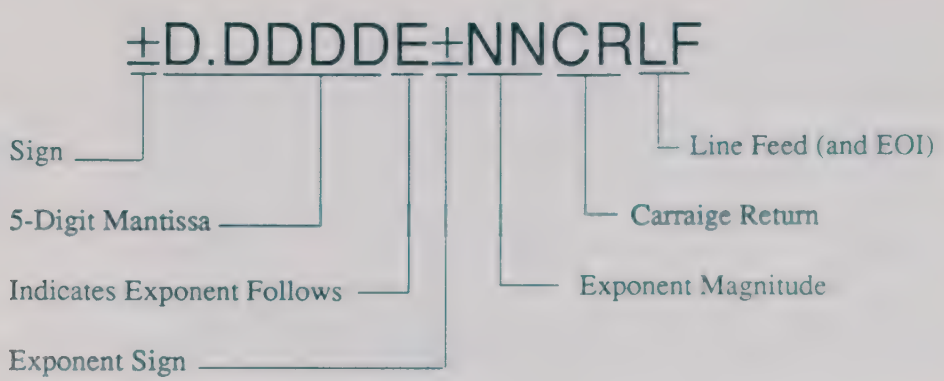


Figure 4-1. Data Output Format

DISPLAY CONTROL

```
OUTPUT 713;"DA"              ! turn on all segments
                             ! and LEDs as a test
OUTPUT 713;"DD"              ! turn off display and
                             ! status LEDs
OUTPUT 713;"DE"              ! turn on display
OUTPUT 713;"DU THIS IS A TEST"  ! display user message
```

The "DA" command is for testing only, and can be cancelled with a "DE" command. The "DU" command allows the user to display messages on the LCD display. The LCD is a two line character display. Up to 32 characters can be sent with the "DU" command. The first 16 characters will be displayed on the top line, and the last 16 will be displayed on the bottom line.

EVENT STATUS REGISTER

The Event Status Register (ESR) is available as a second status byte. It is an 8-bit byte similar to the Status Byte, and is delineated in Table 4-C on the next page. When a specified event occurs, the ESR bits are set true and can be read by sending an "*ESR?" command. When the command is received, the instrument responds by sending an ASCII 3 digit value between 0 and 255 that describes the present state of the register. This ASCII value is arrived at by summing the weighted values of the transmitted bits.

The ESR bits consist of the following:

POWER ON. This bit is set when the instrument's power switch is set from OFF to ON.

COMMAND ERROR. This bit is set when an improper GPIB code is sent to the instrument. The command "WT" would be considered a comand error, for example.

EXECUTION ERROR. When incorrect data is sent to the instrument, this bit will be set. For example, the command "FR-1.0MZ" would be considered an execution error.

DEVICE DEPENDENT ERROR. Errors 1 through 49 are measurement errors, and will set this bit true whenever they occur.

An ESR bit that is set true will cause bit 5 of the Status Byte to be set only when a corresponding bit in the Event Status Enable Register is enabled. This register is somewhat like the Service Request Mask in that it allows the selection of which bit(s) in the ESR register will set bit 5 of the Status Byte.

The Event Status Enable Register is set by sending the program code "*ESE", followed by an ASCII 3 digit value that has been determined by summing the weights of each bit to be checked. Sending the command "*ESE?" will read the current setting of the Event Status Register. The instrument sends an ASCII 3 digit value (determined by summing the weighted values of bits that are set) that describes the current state of the register

Table 4-A. Event Status Register and Event Status Enable Register

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Power On	0	Command Error	Execution Error	Device Dependent Error	0	0	0
Value= 128	Value= 64	Value= 32	Value= 16	Value= 8	Value= 4	Value= 2	Value= 1

FILTERS

The Model 8542 is normally used in the auto filter mode. The power meter chooses an averaging number for the power input range. The power meter uses this number in a digital averaging software routine. Manual averaging numbers can be entered for special circumstances.

```
OUTPUT 713;"AEFA"          ! set auto averaging filtering on
                           ! sensor A
OUTPUT 713;"AEFH"          ! hold present average number
OUTPUT 713;"AEFM0EN"       ! set average number to 1
OUTPUT 713;"AEFM1EN"       ! set average number to 2
OUTPUT 713;"AEFM2EN"       ! set average number to 4
OUTPUT 713;"AEFM3EN"       ! set average number to 8
OUTPUT 713;"AEFM4EN"       ! set average number to 16
OUTPUT 713;"AEFM5EN"       ! set average number to 32
OUTPUT 713;"AEFM6EN"       ! set average number to 64
OUTPUT 713;"AEFM7EN"       ! set average number to 128
OUTPUT 713;"AEFM8EN"       ! set average number to 256
OUTPUT 713;"AEFM9EN"       ! set average number to 512
```

To set averages for the B sensor, replace **"AE"** with **"BE"**.

FREQUENCY

```
OUTPUT 713;"AEFR5.67GZ"          ! enter operating
                                 ! frequency
OUTPUT 713;"AEFR1.0E9HZ"         ! set channel A operating
                                 ! frequency to 1 GHz
OUTPUT 713;"AEFR5.67GZ"          ! set channel A operating
                                 ! frequency to 5.67 GHz
OUTPUT 713;"BEFR84.6MZ"          ! set channel B operating
                                 ! frequency to 84.6 MHz
```

Entering a frequency causes the power meter to use frequency calibration factors stored in the sensors EEPROM. Cal factors are stored in one gigahertz steps. The power meter will interpolate between these numbers for frequencies in between the one gigahertz steps. Valid frequency entries are from 0 Hz to 100,000 GHz. You can enter frequencies in Hertz, Megahertz, and Gigahertz (**"HZ", "MZ", "GZ"**). To cancel the use of cal factors enter a frequency of 0.05 GZ. This is the calibration frequency and is a 0.0 dB calibration factor.

FRONT PANEL CALIBRATOR SOURCE

```
OUTPUT 713;"OC1"        ! turn on calibrator source
OUTPUT 713;"OC0"        ! turn off calibrator source
```

The output of the calibrator will be a fixed 0.00 dBm (1.00 mW) at 50 MHz.

NOTE 1: This command is for instrument testing only. The calibrator source is automatically enabled during the normal calibration procedures.

NOTE 2: The Power Sweep Calibrator REF POWER value is only good for 15 seconds. After that, it will slowly start to drift.

Group Execute Trigger

```
OUTPUT 713;"GT2"    ! Group execute trigger full measurement
                    ! with settling
OUTPUT 713;"GT1"    ! Group execute trigger single measurement
OUTPUT 713;"GT0"    ! Group execute trigger cancel

TRIGGER 713         ! execute a group execute trigger
ENTER 713;Reading   ! Read the data over the bus
PRINT Reading
```

"GT0" Group Trigger Cancel - This disables the response to a GPIB group execute trigger.

"GT1" Trigger Immediate - This mode is the same as "TR1" mode, but waits for a GPIB group execute trigger command before the actual triggering is done.

"GT2" Trigger Immediate with Full Averaging - This mode is the same as "TR2" mode, but waits for a GPIB group execute trigger command before the actual triggering is done.

INSTRUMENT IDENTIFICATION

```
OUTPUT 713;"ID"          ! ask for ID
   or
OUTPUT 713;"?ID"         ! ask for ID
   or
OUTPUT 713;"*IDN?"       ! ask for ID (488.2)

ENTER 713;Name           ! read ID
```

The response to this command is used by user application programs to determine if the correct equipment list is attached to the GPIB bus. There are different requirements for this command at the user level, so the 8542 can be configured to respond differently. The response is menu selectable from the front panel. This feature is for users who cannot re-write their existing programs.

Here are various options:

8541 mode	Name = **"GIGA-TRONICS,8541,0,1.00"**
8542 mode	Name = **"GIGA-TRONICS,8542,0,1.00"**
437 mode	Name = **"HEWLETT-PACKARD,437B,,1.8"**
438 mode	Name = **"HP438A,VER1.10"**
436 mode	Not Applicable

NOTE: "HP" and "Hewlett Packard" are registered trademarks of the Hewlett Packard Company.

INSTRUMENT PRESET

OUTPUT 713;"PR" ! preset the instrument to a known state
or
OUTPUT 713;"*RST" ! preset the instrument to a known state

The preset conditions of the instrument are as follows:

Table 4-B. Instrument Preset Conditions

Parameter	Condition
Sensor A	
CAL FACTOR	100.0%
OFFSET	0.00 dB
Filter	AUTO
Range	AUTO
Low Limit	0.000 dBm
High Limit	0.000 dBm
Sensor B	
CAL FACTOR	100.0%
OFFSET	0.00 dB
Filter	AUTO
Range	AUTO
Low Limit	0.000 dBm
High Limit	0.000 dBm
Measurement Mode	Sensor A
OSC	Off
Entry Channel	SET A
Limits Checking	Off
REL	Off
Trigger Mode	TR3
Group Execute Trigger Mode	GT2
Display Function	Display Enable
LED Peaking Meter Mode	Status
Pulse Sensor Mode	Internal Trigger

NOTE: The preset conditions of measurement units after the "PR" command or front panel command differ. This is to allow compatibility with other instruments over the bus and without penalizing the bench top user.

Table 4-C. GPIB Preset Differences

GPIB Mode	**Measurement Units** (dBm or Watts)
8541	dBm
8542	dBm
438 emulation	Watts
437 emulation	dBm
436 emulation	no change

NOTE: A front panel keyboard preset always sets the units to dBm.

LEARN MODE #1

OUTPUT 713;"LP1" ! set learn mode #1

Learn Modes. The instrument has two learn modes that make use the controller's memory. One mode allows the meter to send instrument configurations to the controller's memory. The second learn mode is a subset of the first.

Whenever data is being transferred between the controller and the meter, it must be in uninterrupted strings. If a string is broken or interrupted, the data could be lost or offset, and misinterpreted by the power meter. An offset of data bytes can remain active until EOI is read.

Learn Mode #1. After receiving an LP1 program code (Learn Mode #1) and when addressed to talk, the instrument sends a string of up to 128 ASCII characters containing information pertaining to the instrument configuration. The last character is sent with EOI bus line true, and terminates the message. The data can be stored in the controller's memory for future use.

When the power meter is addressed to listen, the ASCII data string can be returned to the power meter. The power meter changes accordingly.

Table 4-D on the next page shows the information contained in the string, and the order in which it is sent.

Table 4-D. Learn Mode #1 Output Format

Parameter	Output from Power Meter [1]
Trigger Mode	TRx
Measurement Mode	AP, BP, AR, BR, AD, or BD
Sensor A Parameters	AE
Cal Factor	KB xxx.x EN
Offset	OS sxx.xx EN
Range	RA or RM x EN
Filter	FA or FM x EN
Low Limit	LL sxxx.xxx EN
High Limit	HL sxxx.xxx EN
Sensor B Parameters	BE
Cal Factor	KB xxx.x EN
Offset	OS sxx.xx EN
Range	RA or RM x EN
Filter	FA or FM x EN
Low Limit	LL sxxx.xxx EN
High Limit	HL sxxx.xxx EN
Active Entry Channel	AE or BE
Measurement Units	LG or LN
Reference Oscillator Status	OC0 or OC1
Group Trigger Mode	GTx
Limits Checking Status	LM0 or LM1
Carriage Return Line Feed	EOI

[1] "s" indicates sign; "x" indicates a single digit

LEARN MODE #2

OUTPUT 713;"LP2" ! set learn mode #2

Learn Mode #2. When program code LP2 (Learn Mode #2) has been sent and the instrument has been addressed to talk, the meter sends 2 ASCII characters, @ and 2, followed by a string of 28 (58 for the 437 emulation mode) 8-bit binary bytes. The last byte is sent with EOI bus line true, thus ending the message. This binary data can then be stored in the controller's memory.

The best way to program the system controller is to use a loop to read 30 (60 for the 437 emulation mode) binary characters and store them in an array. Learn Mode #2 requires a controller that can transfer information in binary form.

This string contains the following information:

- Measurement mode
- REL mode status (on or off)
- Reference oscillator status (on or off)
- Current reference value if in REL mode
- Measurement units (Log or Lin)
- Cal Factor for each sensor
- Offset for each sensor
- Range for each sensor
- Filter for each sensor

When the power meter is addressed to listen, the binary data can be returned to the power meter. The power meter changes accordingly.

LIMIT CHECKING

```
OUTPUT 713;"AELH12.34EN"    ! set top line high limit to +12.34 dB
OUTPUT 713;"AELL-2.58EN"    ! set top line low limit to -2.58 dB

OUTPUT 713;"AELM0"          ! disable top line limit checking
OUTPUT 713;"AELM1"          ! enable top line limit checking

OUTPUT 713;"BELH2.34EN"     ! set bottom line high limit to +2.34 dB
OUTPUT 713;"BELH-100.00EN"  ! set bottom line low limit to -100.00 dB

OUTPUT 713;"BELM0"          ! disable bottom line limit checking
OUTPUT 713;"BELM1"          ! enable bottom line limit checking
```

Before enabling limit checking (LM1), you must set the high and low limits (LH and LL). Once enabled, the Status Byte 4 will signal a too high or too low condition (see page 4-33). The status message bytes (AA - see page 4-34) will indicate a too high condition (error cade 21), or a too low condition (error code 23). Status Message bytes L and M contain the limit status for the top line display and the bottom line display respectively. 0 indicates within limits, 1 indicates too high, and 2 indicates too low.

The LCD display will indicate a too high condition with an up arrow displayed to the left of the reading, and a down arrow displayed to the left of the reading for a too low condition. If the sound mode is enabled, a high or low pitched sound will be generated. Sound can be disabled in the SETUP MENU under *SOUND SETUP*.

LOCAL AND REMOTE

```
REMOTE 713          ! set the instrument to remote mode
LOCAL 713           ! set the instrument to local mode
```

When the instrument is in remote mode, the front panel status LED marked REMOTE will be on. Returning the instrument to local mode will turn this LED off. In remote mode, all front panel keys except the 'ENTER' key are disabled. Pressing the 'ENTER' key will return the instrument to local mode.

To disable the ENTER key, place the instrument is local lockout mode. The remote command must be given first.

```
REMOTE 713          ! set the instrument to remote mode
LOCAL LOCKOUT 7     ! set the instrument to local lockout mode
```

In local lockout mode, all keys are disabled. A GPIB local command must be issued to return the instrument to local mode. Disconnecting the GPIB cable will also return the instrument to local.

MAXIMUM POWER VALUE

THIS FUNCTION STILL IN PROCESS

MEASURED OFFSET ENTRY

OUTPUT 713;"APOSDOEN" ! enter measurement A as offset
OUTPUT 713;"BPOSDOEN" ! enter measurement B as offset
OUTPUT 713;"AROSDOEN" ! enter measurement A/B as offset
OUTPUT 713;"BROSDOEN" ! enter measurement B/A as offset
OUTPUT 713;"ADOSDOEN" ! enter measurement A-B as offset
OUTPUT 713;"BDOSDOEN" ! enter measurement B-A as offset

A measurement can be stored as an offset. By specifying the measurement first (e.g. AP or BP), the offset command "OS" will take the letters "DO" in place of a numerical entry. "DO" will return the present measurement data.

MEASUREMENT SELECTION

```
OUTPUT 713;"AP"          ! Measure sensor A
OUTPUT 713;"BP"          ! Measure sensor B

OUTPUT 713;"AR"          ! Measure A/B
OUTPUT 713;"BR"          ! Measure B/A

OUTPUT 713;"AD"          ! Measure A-B
OUTPUT 713;"BD"          ! Measure B-A
```

The above commands will tell the instrument what kind of measurement to make.

```
        OUTPUT 713;"PR"      ! preset the instrument to a
                             ! known state
        OUTPUT 713;"LG"      ! set Log units (dB or dBm)
        OUTPUT 713;"AP"      ! Measure sensor A
Main:                        ! start of measurement loop
        OUTPUT 713;"TR2"     ! Trigger full measurement
                             ! with settling
        ENTER 713;Reading    ! Read the data over the bus
                             ! into variable N

        PRINT Reading
        GO TO Main
```

MINIMUM POWER VALUE

THIS FUNCTION STILL IN PROCESS

OFFSET

```
OUTPUT 713;"AEOS20.00EN"    ! set +20 dB offset to A
OUTPUT 713;"BEOS-15.12EN"   ! set -15.12 dB offset to B
OUTPUT 713;"BE OS 0.0EN"    ! cancel offset for B
OUTPUT 713;"AEOF0"          ! turn off offset
OUTPUT 713;"AEOF1"          ! turn on offset
```

An offset from -99.99 dB to +99.99 dB can be entered.

PARALLEL POLL

The power meter responds to a Parallel Poll Enable (PPE) bus command by sending a bit on a controller-selected GPIB data line.

```
Ppoll_zero:                    ! zero using parallel poll
PRINT "entering parallel poll zero routine"
PPOLL CONFIGURE 713;8          ! configure response on bit zero
OUTPUT 713;"CSAEZE"            ! clear status byte, zero channel A
State=0                        ! initialize variable
WHILE State <> 1               ! stay here until zero done
   State=PPOLL(7)              ! read the poll
   END WHILE
PPOLL UNCONFIGURE 713          ! cancel  parallel poll mode
PRINT "parallel zero done"
RETURN
```

80340 TRIGGERABLE PULSE SENSOR COMMANDS

```
OUTPUT 713;"PULSE A FREERUN"          ! sets the pulse sensor
                                      ! to the freerun mode
OUTPUT 713;"PULSE B INT TRIG"         ! sets the pulse sensor
                                      ! to the internal trigger
                                      ! mode
OUTPUT 713;"PULSE B EXT DLYTRIG"      ! sets the pulse sensor to
                                      ! the external delay
                                      ! trigger mode
```

These commands set the operating mode of the 80340 Series of pulse power sensors. The sensors will default to internal triggering. You can set the sensor to freerun mode to measure CW signals. Internal and external triggering can be immediate ("TRIG") or with delay ("DLYTRIG").

Command String Parameters

PEAK	A	CW (FREERUN)
	B	

PEAK	A	INT	TRIG
	B		DLYTRIG

PEAK	A	EXT	TRIG
	B		DLYTRIG

(NOTE: The PULSE command was used with an earlier version of the 8540 Series Power Meter GPIB communications firmware. PULSE can be used interchangeably with PEAK.)

RELATIVE MEASUREMENTS

```
OUTPUT 713;"AERL1"    ! turn rel mode on and set reference
                      ! level
OUTPUT 713;"AERL0"    ! turn rel mode off
OUTPUT 713;"AERL2"    ! use old relative offset value
```

Sending the RL1 command causes the instrument to take the current power level measurement as the relative offset. After this command, the power level will be 0.00 dBr or 100%. Sending the RL0 command will cancel the relative offset and return the instrument to dBm or Watts.

To set relative modes for the B channel, replace **"AE"** with **"BE"**.

RESOLUTION

```
OUTPUT 713;"AE RE0EN"      ! set display resolution to xx.
OUTPUT 713;"AE RE1EN"      ! set display resolution to xx.x
OUTPUT 713;"AE RE2EN"      ! set display resolution to xx.xx
OUTPUT 713;"AE RE3EN"      ! set display resolution to xx.xxx
```

To set resolution for the B sensor, replace **"AE"** with **"BE"**.

When **"AE"** is specified, the displayed resolution will be set for the top line of the display.

When **"BE"** is specified, the displayed resolution will be set for the bottom line of the display.

NOTE: When the Linear units mode is in use, the display will show engineering notation wherein the resolution keeps the number of digits constant from three to six.

STATUS BYTE MESSAGE

The power meter responds to a Serial Poll Enable (SPE) bus command by sending an 8-bit byte when addressed to talk. If the instrument is holding the SRQ bus control line true (issuing the Require Service message), bit position 6 in the Status Byte and the bit representing the condition causing the Require Service message to be issued will both be true. The bits in the Status Byte are latched, but can be cleared by removing the causing condition and then reading the Status Byte or by receiving the Clear Status (CS) program code.

Status Byte

Bit	7	6	5	4	3	2	1	0
Weight	128	64	32	16	8	4	2	1
Service Request Condition	0	RQS bit Require Service	Event Status	Over/Under LImit	Measurement Error	Entry Error	Cal/Zero Complete	Data Ready

NOTES:
The condition indicated in bits 1 - 5 must be enabled by the Service Request Mask to cause a Service Request Condition. The mask is set with the "@1" program code followed by an 8-bit byte, or the "*SRE" program code followed by three ASCII characters. The value of the byte is determined by summing the weight of each bit to be checked.

The RQS (bit 6) is true when any of the conditions of bits 1 - 5 are enabled and occur. Bits remain set until the Status Byte is cleared.

```
OUTPUT 713;"CS"          ! clear SRQ and status byte
   or
OUTPUT 713;"*CLS"        ! clear SRQ and status byte (488.2)

State = SPOLL(713)       ! read status byte
   or
OUTPUT 713;"*STB?"       ! ask for status byte (488.2)
ENTER 713;State          ! read status byte with 3 ASCII digit
                         ! numbers

OUTPUT 713;"@1";CHR$(4)  ! set service request mask to 4
   or
OUTPUT 713;"*SRE004"     ! set service request mask to 4

OUTPUT 713;"RV"          ! ask for service request mask
   or
OUTPUT 713;"*SRE?"       ! ask for service request mask (488.2)
```

STATUS MESSAGE

```
OUTPUT 713;"SM"          ! ask for status message
ENTER 713;Statusmess$    ! read status message
```

See Figure 4-2, below, and Tables 4-E and 4-F on pages 4-35 and 4-36 for the Status Message Output Format and descriptions of the format.

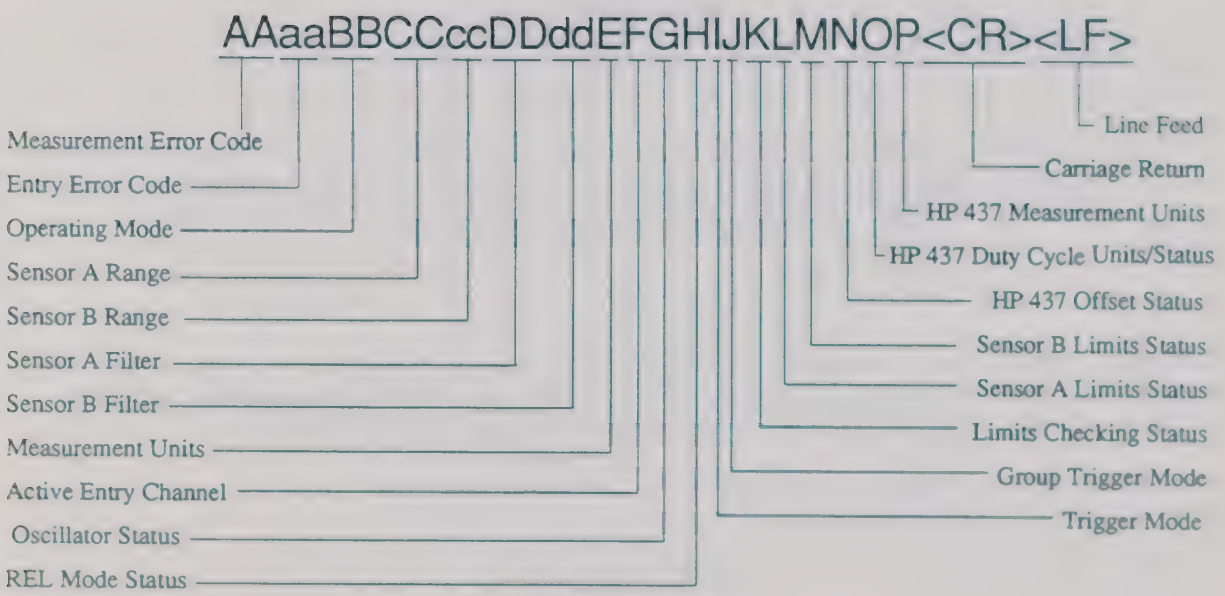


Figure 4-2. Status Message Output Format

NOTE: Each letter in the Status Message Output Format denotes a single ASCII character. This equals either 23 or 26 (for the 437 emulation mode) characters.

Table 4-E. Error Codes Returned in Location AAaa as Shown in Figure 4-2 on Page 4-34

Error Code	Message	Action Required
SM byte 1,2(AA)00	All ok	
01	Cannot zero sensor A	Ensure no RF power to sensor A
02	Cannot zero sensor B	Ensure no RF power to sensor B
03	Sensor A not connected to Calibrator	Connect sensor A to Calibrator
04	Sensor B not connected to Calibrator	Connect sensor B to Calibrator
05	Cannot Cal Sensor A	Check sensor A connection to Calibrator. Reference must be 1.00 mW.
06	Cannot Cal sensor B	Check sensor B connection to Calibrator. Reference must be 1.00 mW.
31	No sensor on Channel A	Connect sensor A or change channels (if B connected)
32	No sensor on Channel B	Connect sensor B or change channels (if A connected)
SM byte 3,4 (aa)00	All ok	
50	Entered Cal Factor out of range	Re-enter value between 1.0% and 150.0%
51	Entered Offset out of range	Re-enter value between -99.99 dB and +99.99 dB
53	Entered avg. no. is out of range	Re-enter valid average number
54	Entered recall mem no. out of range	Re-enter valid recall memory number between 0 and 20
55	Entered store mem no. out of range	Re-enter valid store memory number between 1 and 20
56	Entered ref cal factor out of range	Re-enter ref cal factor number between 50 and 120%
57	Memory error or battery failure	Check battery or perform cal procedure to check memory
90	GPIB data without valid prefix	Check, then re-enter valid prefix with data
91	Invalid GPIB code	Check, then re-enter correct GPIB code

Table 4-F. Codes Used in Status Messages

BB	CC cc	DD dd	E	F	G	H	I	J	K	LM
Operating Mode	Range	Filter	Measurement Units	Active Entry Channel	Osc. Status	REL Mode Status	Trigger Mode	Group Trigger	Limits Checking Status	Sensor A & B Limits Status
00=Sensor A 01=Sensor B 02=A/B 03=B/A 04=A-B 05=B-A 06=Zeroing A 07=Zeroing B 08=Cal A 09=Cal B 10=Ext Cal A 11=Ext Cal B	Manual Range 01=1 02=2 03=3 04=4 05=5 Auto Range 11=1 12=2 13=3 14=4 15=5	Manual Filter 00=1 01=1 02=2 03=3 04=4 05=5 06=6 07=7 08=8 09=9 Auto Filter 10=0 11=1 12=2 13=3 14=4 15=5 16=6 17=7 18=8 19=9 437 Mode 1, 2, 4, 8, 16, 32, 64, 128, 256, 512	0=Watts 1=dBm	A=A B=B	0=Off 1=On	0=Off 1=On	0=Free Run 1=Hold	0=GT0 1=GT1 2=GT2	0=Disabled 1=Enabled	0=In Limits 1=Over high limit 2=Under low limit 3=Over high limit and under low limit

STORE AND RECALL

```
OUTPUT 713;"ST12EN"   ! store instrument state in register 12
OUTPUT 713;"RC3EN"    ! recall instrument state in register 3
OUTPUT 713;"RC0EN"    ! recall previous instrument state
```

Registers 1 through 20 are available for store and recall. Register 0 contains the previous state of the instrument and can be used to recover from any entry error by a recall 0 command.

SWIFT and BURST MODE FORMATS

```
±DDD.DD CRLF                    ! one sensor swift mode
±DDD.DD, ±DDD.DD CRLF           ! two sensor swift mode

±DDD.DD, . . . . ., ±DDD.DD CRLF    ! Burst mode
```

SWIFT MEASUREMENT MODE

```
OUTPUT 713;"SWIFT FREERUN"          ! set free run mode
OUTPUT 713;"SWIFT GET BUFFER 120"   ! 120 readings using
                                    ! group execute trigger
OUTPUT 713;"SWIFT TTL BUFFER 100"   ! 100 readings using
                                    ! TTL trigger
OUTPUT 713;"SWIFT OFF"              ! cancel swift mode
```

Command String Parameters

SWIFT	FREERUN		
	GET	BUFFER	1 (thru) 5000
	TTL		
	OFF		

The Swift mode allows the user to make faster measurements. Volts to dBm conversions are done in table look ups instead of floating point math. Loss of accuracy is typically no more than 0.02 dB. The following program shows the free run trigger mode:

```
OUTPUT 713;"SWIFT FREERUN"
WAIT 0.5
FOR I=1 TO 20
      ENTER 713;Reading
      PRINT Reading
NEXT I
OUTPUT 713;"SWIFT OFF"
```

The next example shows the group execute trigger mode. The instrument will wait until the buffer is full and ready to send out the data. You can use SRQs to check readiness. The instrument asserts SRQ after each GET trigger.

(continued on page 4-40)

```
REAL Data(30)
OUTPUT 713;"SWIFT GET BUFFER 30"
WAIT 0.5                    ! wait for instrument configuration
FOR I=1 TO 30
        Srq_flag=0          ! wait for ready condition
        TRIGGER 713         ! trigger measurement
WHILE Srq_flag=0
        Srq_flag=SPOLL(713)
        END WHILE
NEXT I
        ENTER 713;Data(*)
        FOR I=1 TO 30
        PRINT I,Data(I)
NEXT I
```

NOTE: If your computer does not support (*) matrix reads, you can read the entire buffer into a string and parse the data. Multiple ENTER commands will not work.

TTL triggering can also be used. The instrument outputs a TTL high on the TRIGGER BNC rear panel input. The RF BNC output will go low until the power meter is ready for another trigger.

8542 Users:

If you have two sensors attached to the power meter, the swift mode will measure both channels at the same time. The instrument must be configured for single sensor reading (i.e. "APBP"). The program now needs to do double reads.

```
OUTPUT 713;"APBP"
OUTPUT 713;"SWIFT FREERUN"
WAIT 0.5
FOR I=1 TO 20
        ENTER 713;ReadA,ReadB
        PRINT ReadA,ReadB
NEXT I
OUTPUT 713;"SWIFT OFF"
```

(continued on page 4-41)

```
REAL DataA(30),DataB(30)
OUTPUT 713;"SWIFT GET BUFFER 30"
WAIT 0.5
FOR I=1 TO 30
        srq_flag=0
        TRIGGER 713                ! send group execute trigger
WHILE srq_flag=0
        srq_flag=SPOLL (713)
        END WHILE
NEXT I
ENTER 713;DataA(*),DataB(*)     ! read the buffer
FOR I=1 TO 30
        PRINT I,DataA(I),DataB(I)
NEXT I
```

TRIGGERING A MEASUREMENT

```
OUTPUT 713;"TR3"      ! Free run trigger mode
OUTPUT 713;"TR2"      ! Trigger full measurement with settling
OUTPUT 713;"TR1"      ! Trigger single measurement
OUTPUT 713;"TR0"      ! Trigger hold mode

ENTER 713;Reading     ! Read the data over the bus
PRINT Reading
```

The above commands define the trigger modes which determine when the measurement will be made. The default (preset) mode is "TR3".

"TR0" Trigger Hold - This mode places the instrument in standby mode. In this mode the LCD is frozen at the current values. The display will be updated when the instrument receives a "TR1" or "TR2" command. To resume normal free run mode of the instrument and display, use the "TR3" command. During the standby mode, the instrument continues to make measurements and update the internal digital filter, but does not update the display or the GPIB buffer.

"TR1" Trigger Immediate - This command triggers a single reading and adds this reading to the internal digital filter. An "ENTER" statement will return the updated filter power level. After a "TR1" command, the instrument returns to the standby mode.

"TR2" Trigger Immediate with Full Averaging - This mode triggers a new series of reading; enough to update the digital filter for a noise free reading at the current power level. An "ENTER" statement will return the fully updated filter power level. After a "TR2" command, the instrument returns to the standby mode.

"TR3" Free Run - This mode allows the user to read the power at any time with an "ENTER" statement. There is no need to re-send the "TR3" command. Multiple "ENTER" statements can be executed. The power meter will return the present power level just as if you had looked at the LCD display.

UNITS

OUTPUT 713;"LG" ! set Log units (dB or dBm)
OUTPUT 713;"LN" ! set Linear units (Watts or %)

These commands set the type of units in which the measurement will be displayed. All measurements are affected except Swift and Burst modes. These modes always return measurement readings in dBm units.

USING SERIAL POLLS

```
Srq_zero:                          ! zero with an srq interrupt
PRINT "entering SRQ interrupt zero routine"
ON INTR 7 GOSUB Srq_interrupt
OUTPUT 713;"CS"                    ! clear status byte
ENABLE INTR 7;2                    ! enable srq interrupts
OUTPUT 713;"@1";CHR$(2)            ! enable srq handshake
OUTPUT 713;"AEZE"                  ! execute zero command
Flag=0                             ! test flag reset to flase
WHILE Flag=0                       ! stay here until test flag set true
   WAIT 1
   PRINT "Still inside while loop"
END WHILE
PRINT "SRQ interrupt zero done"
RETURN

Srq_interrupt:                     ! SRQ interrupts jump here
PRINT "an SRQ interrupt has occured"
OUTPUT 713;"CS"                    ! clear status byte
Flag=1                             ! set control flag true
RETURN
```

VOLTAGE PROPORTIONAL TO FREQUENCY FUNCTION

THIS FUNCTION STILL IN PROCESS

ZERO

```
OUTPUT 713;"AEZE"          ! Zero sensor A
OUTPUT 713;"BEZE"          ! Zero sensor B
```

If the sensor is attached to an RF source, the source must be turned off before a zero can occur. Zeroing with RF applied will not work.

Zeroing before calibration is not needed. The calibration command will automatically perform a zero before calibrating.

```
Spoll_zero:                ! zeroing with a serial poll
OUTPUT 713;"CS"            ! clear status byte
OUTPUT 713;"AEZE"          ! execute zero command
State=0                    ! initialize variable
WHILE State = 0            ! stay here until zero is done
      State = SPOLL(713)   ! read serial poll status byte
END WHILE
RETURN
```

TYPICAL APPLICATION PROGRAMS

```
    OUTPUT 713;"TR3"              ! set freerun mode
Main:
    ENTER 713;Reading             ! make reading
    PRINT Reading
    GO TO MAIN
```

```
    OUTPUT 713;"PR"               ! preset the instrument to a
                                  ! known state
    OUTPUT 713;"LG"               ! set Log units (dB or dBm)
    OUTPUT 713;"AP"               ! Measure sensor A
Main:                             ! start of measurement loop
    OUTPUT 713;"TR2"              ! Trigger full measurement
                                  ! with settling
    ENTER 713;Reading             ! Read the data over the bus
                                  ! into variable N
    PRINT Reading
    GO TO Main

Calibrate:                        ! calibration routine
ON INTR 7 GOSUB Srq_interrupt     ! setup serial poll interrupt
                                  ! jump location
ENABLE INTR 7;2                   ! enable SRQ interrupts
OUTPUT 713;"*SRE002"              ! set service request mask to 2
OUTPUT 713;"CS"                   ! clear status byte
OUTPUT 713;"CL100EN"              ! start calibration
Flag=0                            ! reset control flag
WHILE Flag=0                      ! wait while calibrating
END WHILE
RETURN

Srq_interrupt:                    ! SRQ interrupts jump here
IF BIT(State, 1) THEN
    PRINT "GOOD CAL"
    ELSE
        IF BIT(State, #) THEN
            PRINT "BAD CAL"
            ENDIF
ENDIF
OUTPUT 713;"CS"                   ! clear status byte
Flag=1                            ! set control flag true
RETURN
```

```
CSUB        PROG        494         RE-STORE          "WSPEED"
11    ! SPEED TESTS FOR THE GIGA-TRONICS 8542
12    ! 2/7/92
20    Giga-tronics=713
30    DIM A(100) ,B(100)
31    OUTPUT Giga-tronics;"PRLGOC1"
32    OUTPUT Giga-tronics;"AEFM0EN"
34    OUTPUT Giga-tronics;"DU GIGA-TRONICS 8542 SPEED TESTS"
35    WAIT 1
36    OUTPUT Giga-tronics;"DUUN-PLUG 'B' SENSOR"
37    PRINT
40    PRINT "GIGA-TRONICS 8542 SPEED TESTS"
60    PRINT "CONNECT 'A' SENSOR ONLY. NO 'B' SENSOR"
61    PRINT "PRESS RETURN WHEN READY"
70    INPUT A$
71    OUTPUT Giga-tronics;"DE"
80    !
90    PRINT
100   PRINT "NORMAL TR3 TRIGGER MODE SINGLE CHANNEL"
110   GOSUB Timeloop1
111   !
112   PRINT
113   PRINT "NORMAL TR2 TRIGGER MODE SINGLE CHANNEL"
114   GOSUB Timeloop4
120   !
130   OUTPUT Giga-tronics;"SWIFT FREERUN"
140   WAIT 1
150   PRINT
160   PRINT "SWIFT MODE SINGLE CHANNEL"
170   GOSUB Timeloop2
180   OUTPUT Giga-tronics;"SWIFT OFF"
181   !
190   PRINT
200   PRINT "END OF SINGLE CHANNEL MODE"
210   PRINT "CONNECT 'B' SENSOR FOR NEXT SET OF TESTS"
211   PRINT "PRESS RETURN WHEN READY"
212   OUTPUT Giga-tronics;"DUCONNECT 'B' SENSOR"
220   INPUT A$
221   OUTPUT Giga-tronics;"DE"
223   !
230   PRINT
240   PRINT "NORMAL TR3 TRIGGER MODE TWO CHANNELS"
250   GOSUB Timeloop3
251   !
260   PRINT
270   PRINT "SWIFT MODE DUAL CHANNEL"
280   OUTPUT Giga-tronics;"SWIFT FREERUN"
290   WAIT 1
300   GOSUB Timeloop2
310   PRINT
320   OUTPUT Giga-tronics;"SWIFT OFF"
330   PRINT "END OF TESTS"
340   STOP
```

```
350   !
360 Timeloop1:    ! SINGLE CHANNEL MEASUREMENTS
370   T1=TIMEDATE
380   FOR I=1 TO 100
390   ENTER Giga-tronics;A(I)
400 ! PRINT A(I)
410   NEXT I
420   T2=TIMEDATE
430   PRINT 100/(T2-T1);"PER SECOND"
440 ! FOR I=1 TO 100
450 ! PRINT A(I)
460 ! NEXT I
470 ! PRINT
480   RETURN
490   !
500 Timeloop2:    ! TWO CHANNELS IN SWIFT MODE
510   T1=TIMEDATE
520   FOR I=1 TO 100
530   ENTER Giga-tronics;A(I),B(I)
540   NEXT I
550   T2=TIMEDATE
560   PRINT 100/(T2-T1);"PER SECOND FOR BOTH CHANNELS"
570   RETURN
580   !
590 Timeloop3:    !
600   T1=TIMEDATE
610   FOR I=1 TO 100
620   OUTPUT Giga-tronics;"AP"
630   ENTER Giga-tronics;A(I)
640   OUTPUT Giga-tronics;"BP"
650   ENTER Giga-tronics;B(I)
660   NEXT I
670   T2=TIMEDATE
680   PRINT 100/(T2-T1);"PER SECOND BOTH CHANNELS"
690   OUTPUT Giga-tronics;"AP"
700   RETURN
701   !
702 Timeloop4:    !
703   T1=TIMEDATE
704   FOR I=1 TO 100
705   OUTPUT Giga-tronics;"TR2"
706   ENTER Giga-tronics;A(I)
709   NEXT I
710   T2=TIMEDATE
711   PRINT 100/(T2-T1);"PER SECOND SINGLE CHANNEL"
712   OUTPUT Giga-tronics;"TR3"
713   RETURN
714   END
```

```
10 ! RE-STORE "SWIFT"
20 !
30 ! DEMO PROGRAM FOR 8540 SWIFT MODE
40 !
50 ! 2/13/92
50 !
70    Giga-tronics=713
80    N=100
90    OPTION BASE 1
110   REAL Nums(100)
120   OUTPUT Giga-tronics;"PRLG"
130   OUTPUT Giga-tronics;"SWIFT FREERUN"
140   WAIT .5
145   WINDOW 1 ,N,-70,20
150 Mainloop
151   FOR I=1 TO N
170   ENTER Giga-tronics;Nums(I)
180   NEXT I
190   GCLEAR
200   PEN 2
210   GRID 10,10
220   PEN 1
230   MOVE 1 ,Nums(I)
240   FOR I=1 TO N
250     DRAW I ,Nums (I)
260   NEXT I
270 GOTO Mainloop
280   OUTPUT Giga-tronics;"SWIFT OFF"
300   END
```

```
10 ! RE-STORE "SWIFT"
20 ! DEMO PROGRAM FOR 8540 SWIFT MODE
40 !
50 ! 2/13/92
60 !
70    Giga-tronics=713
80    N=100
90    OPTION BASE 1
110   REAL Nums(100)
120   OUTPUT Giga-tronics;"PRLG"
130   OUTPUT Giga-tronics;"SWIFT GET";N
140   WAIT .5
145   WINDOW 1,N-70,20
150 Mainloop
151   FOR I=1 TO N
160   TRIGGER Giga-tronics
161   NEXT I
170   ENTER Giga-tronics;Nums(*)
190   GCLEAR
200   PEN 2
210   GRID 10,10
220   PEN 1
230   MOVE 1,Nums(1)
240   FOR I=1 TO N
250     DRAW I,Nums(I)
260   NEXT I
270 GOTO Mainloop
280   OUTPUT Giga-tronics;"SWIFT OFF"
300   END
```

```
10 ! RE-STORE "BURST"
20 !
30 ! DEMO PROGRAM FOR 8540 BURST MODE
40 !
50 ! 2/13/92
60 !
70    Giga-tronics=713
80    N=100
90    OPTION BASE 1
110   REAL Nums(100)
120   OUTPUT Giga-tronics;"PRLG"
130   OUTPUT Giga-tronics;"BURST POST GET BUFFER";N
140   WAIT .5
145   WINDOW 1,N,-70,20
150 Mainloop
152   Wait .05
160   TRIGGER Giga-tronics
170   ENTER Giga-tronics;Nums(*)
190   GCLEAR
200   PEN 2
210   GRID 10,10
220   PEN 1
230   MOVE 1,Nums(1)
240   FOR I=1 TO N
250     DRAW I,Nums(I)
260   NEXT I
270 GOTO Mainloop
280   OUTPUT Giga-tronics;"BURST OFF"
300   END
```

```
10 ! RE-STORE "BURST"
20 !
30 ! DEMO PROGRAM FOR 8540 BURST MODE WITH TTL TRIGGER
40 !
50 ! 2/13/92
60 !
70    Giga-tronics=713
80    N=200
90    OPTION BASE 1
110   REAL Nums(200)
120   OUTPUT Giga-tronics;"PRLG"
130   OUTPUT Giga-tronics;"BURST POST TTL BUFFER";N
140   WAIT .5
145   WINDOW 1,N,-70,20
150 Mainloop
170   ENTER Giga-tronics;Nums(*)     ! waits here until TTL trigger happens
190   GCLEAR
200   PEN 2
210   GRID N/10,10
220   PEN 1
230   MOVE 1,Nums(1)
240   FOR I=1 TO N
250     DRAW I,Nums(I)
260   NEXT I
270 GOTO Mainloop
300   END
```

8540 SERIES GPIB COMMAND SET (in alphabetical order)

These are the GPIB commands available when the instrument is placed in the 8541 and 8542 mode. (Page numbers indicate where descriptions of the specific commands can be located.)

"@1" ! set service request mask ..... (page 4-33)
"@2" ! set learn mode 2 data ..... (page 4-21)
"*CLS" ! clear status byte (the 488.2 way) ..... (page 4-33)
"*ESE" ! set Event Status Enable Register ..... (page 4-10)
"*ESE?" ! read current status of Event Status Enable Register ..... (page 4-10)
"*ESR?" ! read and clear Event Status Register bits ..... (page 4-10)
"*RST" ! software preset ..... (page 4-17)
"*STB?" ! ask for status byte (the 488.2 way) ..... (page 4-33)
"*SRE004" ! set service request mask to 4 ..... (page 4-33)
"*SRE?" ! ask for service request mask ..... (page 4-33)
"*TST" ! self test output
"?ID" ! ask for ID (the old way) ..... (page 4-16)
"*IDN?" ! ask for ID (the 488.2 way) ..... (page 4-16)
"AD" ! Measure A-B ..... (page 4-26)
"ADOSDOEN" ! enter measurement A-B as offset ..... (page 4-25)
"AE" ! set sensor A
"AE MAX" ! Output channel 1 Maximum value ..... (page 4-24)
"AE MIN" ! Output channel 1 Minimum value ..... (page 4-27)
"AE MN0 ! Disable channel 1 Min/Max function ..... (page 4-27)
"AE MN1" ! Enable channel 1 Min/Max function ..... (page 4-24)
"ANALOG1" ! Configure Analog port A ..... (page 4-3)
"ANALOG2" ! Configure Analog port B ..... (page 4-3)
"AP" ! Measure sensor A ..... (page 4-26)
"APOSDOEN" ! enter measurement A as offset ..... (page 4-25)
"AR" ! Measure A/B ..... (page 4-26)
"AROSDOEN" ! enter measurement A/B as offset ..... (page 4-25)
"BD" ! Measure B-A ..... (page 4-26)
"BDOSDOEN" ! enter measurement B-A as offset ..... (page 4-25)
"BE" ! set sensor B
"BE MAX" ! Output channel 2 Maximum value ..... (page 4-24)
"BE MIN" ! Output channel 2 Minimum value ..... (page 4-27)
"BE MN0" ! Disable channel 2 Min/Max function ..... (page 4-27)
"BE MN1" ! Enable channel 2 Min/Max function ..... (page 4-24)
"BP" ! Measure sensor B ..... (page 4-26)
"BPOSDOEN" ! enter measurement B as offset ..... (page 4-28)
"BR" ! Measure B/A ..... (page 4-26)
"BROSDOEN" ! enter measurement B/A as offset ..... (page 4-25)
"BURST DUMP" ! dump burst mode ..... (page 4-4)
"BURST OFF" ! cancel burst mode ..... (page 4-4)
"BURST POST GET BUFFER 200" ..... (page 4-4)
"CL100EN" ! Calibrate sensor (preceed with AE or BE) ..... (page 4-5)

8540 SERIES GPIB COMMAND SET (cont.)

"CS" ! clear status byte ..... (page 4-33)
"DA" ! turn on all segments and LEDs as a test ..... (page 4-9)
"DD" ! turn off display ..... (page 4-9)
"DE" ! turn on display ..... (page 4-9)
"DU THIS IS A TEST" ! display user message ..... (page 4-9)
"FA" ! set auto average filtering (preceed with AE or BE) ..... (page 4-12)
"FH" ! hold present average number (preceed with AE or BE) (page 4-12)
"FM0EN" ! set average number to 1 (preceed with AE or BE) ..... (page 4-12)
"FM1EN" ! set average number to 2 (preceed with AE or BE) ..... (page 4-12)
"FM2EN" ! set average number to 4 (preceed with AE or BE) ..... (page 4-12)
"FM3EN" ! set average number to 8 (preceed with AE or BE) ..... (page 4-12)
"FM4EN" ! set average number to 16 (preceed with AE or BE) ..... (page 4-12)
"FM5EN" ! set average number to 32 (preceed with AE or BE) ..... (page 4-12)
"FM6EN" ! set average number to 64 (preceed with AE or BE) ..... (page 4-12)
"FM7EN" ! set average number to 128 (preceed with AE or BE) ... (page 4-12)
"FM8EN" ! set average number to 256 (preceed with AE or BE) ... (page 4-12)
"FM9EN" ! set average number to 512 (preceed with AE or BE) ... (page 4-12)
"FR" ! enter operating frequency ..... (page 4-13)
"GT0" ! Group execute trigger cancel ..... (page 4-15)
"GT1" ! Group execute trigger single measurement ..... (page 4-15)
"GT2" ! Group execute trigger full measurement with settling .. (page 4-15)
"ID" ! ask for instrument ID ..... (page 4-16)
"KB99EN" ! enter 99% cal factor (preceed with AE or BE) ..... (page 4-6)
"LG" ! set Log units (dB or dBm) ..... (page 4-43)
"LM0" ! disable limit checking ..... (page 4-22)
"LM1" ! enable limit checking ..... (page 4-22)
"LN" ! set Linear units (Watts or %) ..... (page 4-43)
"LH21.35EN" ! set high limit to +21.35 dBm (preceed with AE or BE) (page 4-22)
"LL-12.15EN" ! set low limit to -12.15 dBm (preceed with AE or BE) . (page 4-22)
"LP1" ! set learn mode #1 ..... (page 4-19)
"LP2" ! set learn mode #2 ..... (page 4-21)
'MAX" ! Turn on Maximum value function ..... (page 4-24)
"MIN" ! Turn on Minimum value function ..... (page 4-27)
"OC0" ! turn off calibrator source ..... (page 4-14)
"OC1" ! turn on calibrator source ..... (page 4-14)
"OF0" ! turn off offset ..... (page 4-28)
"OF1" ! turn on offset ..... (page 4-28)
"OS20.00EN" ! set +20 dB offset (preceed with AE or BE) ..... (page 4-28)
"PR" ! preset the instrument to a known state ..... (page 4-17)
"PULSE A FREERUN" ! sets the pulse sensor to the freerun mode ..... (page 4-30)
"PULSE B INT TRIG" ! sets the pulse sensor to internal trigger mode ..... (page 4-30)
"PULSE B EXT DLYTRIG" ! sets the pulse sensor to external delay trigger mode ..... (page 4-30)

```
"RC0EN"          ! recall previous instrument state ..... (page 4-37)
"RC3EN"          ! recall instrument state in register 3 ..... (page 4-37)
"RE0"            ! set display resolution to xx. ..... (page 4-32)
"RE1"            ! set display resolution to xx.x ..... (page 4-32)
"RE2"            ! set display resolution to xx.xx ..... (page 4-32)
"RE3"            ! set display resolution to xx.xxx ..... (page 4-32)
"RL0"            ! turn off rel mode (preceed with AE or BE) ..... (page 4-31)
"RL1"            ! turn on rel mode (preceed with AE or BE) ..... (page 4-31)
"RL2"            ! use old relative offset value ..... (page 4-31)
"RV"             ! ask for status request mask ..... (page 4-33)
"SM"             ! ask for status message ..... (page 4-34)
"ST12EN"         ! store instrument state in register 12 ..... (page 4-37)
"SWIFT FREERUN"  ! set free run mode ..... (page 4-39)
"SWIFT GET 120"  ! 120 readings using group execute trigger ..... (page 4-39)
"SWIFT OFF"      ! cancel fast mode ..... (page 4-39)
"SWIFT TTL 100"  ! 100 readings using TTL trigger ..... (page 4-39)
"TR0"            ! Trigger hold mode ..... (page 4-42)
"TR1"            ! Trigger single measurement ..... (page 4-42)
"TR2"            ! Trigger full measure with settling ..... (page 4-42)
"TR3"            ! Free run trigger mode ..... (page 4-42)
"VPROPF1"        ! Turn on VpropF for channel 1 ..... (page 4-45)
"VPROPF2"        ! Turn on VpropF for channel 2 ..... (page 4-45)
"ZE"             ! Zero Instrument ..... (page 4-46)
```

437 Emulation Mode Command Set (alphabetical)
(These are the GPIB commands available when the instrument is placed in the 437 emulation mode)

"CL"	! CAL [1]	(page 4-5)
"*CLS"	! Clear all Status Registers [2]	(page 4-33)
"CS"	! Clear the Status Byte	(page 4-33)
"CT0 - CT9"	! clear sensor data tables 0 thru 9	**Not Supported**
"DA"	! All display segments on	(page 4-9)
"DC0"	! Duty Cycle on	**Not Supported**
"DC1"	! Duty Cycle off	**Not Supported**
"DD"	! Display disable	(page 4-9)
"DE"	! Display enable	(page 4-9)
"DN"	! down arrow emulation	**Not Supported**
"DU"	! Display user message	(page 4-9)
"DY"	! Duty Cycle (enter duty cycle value)	**Not Supported**
"EN"	! ENTER	
"ERR?"	! device error query	**Not Supported**
"*ESE"	! set the event status enable mask [3]	(page 4-10)
"*ESE?"	! event status register enable mask query [3]	(page 4-10)
"*ESR?"	! event status register query [3]	(page 4-10)
"ET0 - ET9"	! edit sensor cal factor table 0 thru 9	**Not Supported**
"EX"	! exit	**Not Supported**
"FA"	! automatic filter selection	(page 4-12)
"FH"	! filter hold	(page 4-12)
"FM"	! manual filter selection [1]	(page 4-12)
"FR"	! frequency entry	(page 4-13)
"GT0"	! ignore Group Execute Trigger (GET) bus command	(page 4-15)
"GT1"	! trigger immediate response to GET command	(page 4-15)
"GT2"	! trigger with Delay response to GET command	(page 4-15)
"GZ"	! giga hertz	(page 4-13)
"HZ"	! hertz	(page 4-13)
"ID"	! GPIB identification query	(page 4-16)
"*IDN?"	! GPIB identification query [2]	(page 4-16)
"KB"	! Cal Factor [1]	(page 4-6)
"KZ"	! kilo hertz	(page 4-13)
"LG"	! Log display	(page 4-43)
"LH"	! high limit [1]	(page 4-22)
"LL"	! low limit [1]	(page 4-22)
"LM0"	! disable limits checking function	(page 4-22)
"LM1"	! enable limits checking function	(page 4-22)
"LN"	! Linear display	
"LP2"	! HP 437 learn mode	(page 4-21)
"LT"	! left arrow	**Not Supported**

437 Emulation Mode Command Set (cont.)

"MZ"	! mega hertz	(page 4-13)
"OC0"	! reference oscillator off	(page 4-14)
"OC1"	! reference oscillator on	(page 4-14)
"OD"	! output display text	**Not Supported**
"OF0"	! offset off - Local	(page 4-28)
"OF1"	! offset on - Local	(page 4-28)
"OS"	! OFFSET (enter offset value)	(page 4-28)
"PCT"	! Percent (can terminate Duty Cycle, Cal Fac, & Ref CF)	
"PR"	! PRESET	(page 4-17)
"RA"	! Auto range	
"RC"	! Recall [1]	(page 4-37)
"RE"	! resolution [1]	(page 4-32)
"RF0 - RF9"	! enter sensor ref cal factor	**Not Supported**
"RH"	! range hold	**Not Supported**
"RL0"	! exit REL mode	(page 4-31)
"RL1"	! enter REL mode using REL value	(page 4-31)
"RL2"	! use old ref number	(page 4-31)
"RM"	! Set range [1]	**Not Supported**
"*RST"	! soft reset	(page 4-17)
"RT"	! right arrow	**Not Supported**
"RV"	! read Service Request Mask value	(page 4-33)
"SE"	! sensor	**Not Supported**
"SM"	! Status Message	(page 4-34)
"SN0 - SN9"	! enter sensor serial number	**Not Supported**
"SP"	! special	**Not Supported**
"*SRE"	! set the Service Request Mask value [2]	(page 4-33)
"*SRE?"	! Service Request Mask query	(page 4-33)
"ST"	! STORE 1	(page 4-33)
"*STB?"	! read the Status Byte	(page 4-33)
"TR0"	! trigger hold	(page 4-42)
"TR1"	! trigger immediate	(page 4-42)
"TR2"	! trigger with delay	(page 4-42)
"TR3"	! trigger - free run	(page 4-42)
"*TST?"	self test query	
"UP"	! up arrow	**Not Supported**
"ZE"	! ZERO	(page 4-46)
"@1"	! prefix for Status Mask	(page 4-33)
"@2"	! learn mode prefix	(page 4-21)
"%"	! can be used for CAL FACTOR and REF CF	

[1] A numeric entry is required by these GPIB codes, followed by the code "EN" (ENTER).
[2] This GPIB code uses the next 6 characters (0-9, A-Z, or an underscore) as input data.
[3] The "*" must be included as part of the GPIB command string.

438 Emulation Mode Command Set (alphabetical)
(These are the GPIB commands available when the instrument is placed in the 438 emulation mode)

"?ID" ! ask for ID (the old way) ..... (page 4-16)
"@1" ! prefix for Service Request Mask ..... (page 4-19)
"@1";CHR$(4) ! set Service Request Mask to 4 ..... (page 4-33)
"AD" ! Measure A-B ..... (page 4-26)
"ADOSDOEN" ! enter measurement A-B as offset ..... (page 4-25)
"AE" ! set A ..... (page 4-26)
"AP" ! Measure sensor A ..... (page 4-26)
"APOSDOEN" ! enter measurement A as offset ..... (page 4-25)
"AR" ! Measure A/B ..... (page 4-26)
"AROSDOEN" ! enter measurement A/B as offset ..... (page 4-25)
"BD" ! Measure B-A ..... (page 4-26)
"BDOSDOEN" ! enter measurement B-A as offset ..... (page 4-28)
"BE" ! set B ..... (page 4-26)
"BP" ! Measure sensor B ..... (page 4-26)
"BPOSDOEN" ! enter measurement B as offset ..... (page 4-28)
"BR" ! Measure B/A ..... (page 4-28)
"BROSDOEN" ! enter measurement B/A as offset ..... (page 4-26)
"CL" ! CAL ADJ ..... (page 4-5)
"CL100EN" ! Calibrate sensor (preceed with AE or BE) ..... (page 4-5)
"CS" ! clear status byte ..... (page 4-16)
"DA" ! display all ..... (page 4-9)
"DD" ! display disable ..... (page 4-9)
"DE" ! display enable ..... (page 4-9)
"DO" ! DSP - OFS ..... (page 4-25)
"EN" ! ENTER
"FA" ! set auto average filtering (preceed with AE or BE) ..... (page 4-12)
"FH" ! hold present average number (preceed with AE or BE) ..... (page 4-12)
"FM0EN" ! set average number to 1 (preceed with AE or BE) ..... (page 4-12)
"FM1EN" ! set average number to 2 (preceed with AE or BE) ..... (page 4-12)
"FM2EN" ! set average number to 4 (preceed with AE or BE) ..... (page 4-12)
"FM3EN" ! set average number to 8 (preceed with AE or BE) ..... (page 4-12)
"FM4EN" ! set average number to 16 (preceed with AE or BE) ..... (page 4-12)
"FM5EN" ! set average number to 32 (preceed with AE or BE) ..... (page 4-12)
"FM6EN" ! set average number to 64 (preceed with AE or BE) ..... (page 4-12)
"FM7EN" ! set average number to 128 (preceed with AE or BE) ..... (page 4-12)
"FM8EN" ! set average number to 256 (preceed with AE or BE) ..... (page 4-12)
"FM9EN" ! set average number to 512 (preceed with AE or BE) ..... (page 4-12)
"GT0" ! Group execute trigger cancel ..... (page 4-15)
"GT1" ! Group execute trigger single measurement ..... (page 4-15)
"GT2" ! Group execute trigger full measurement with settling ..... (page 4-15)

438 Emulation Mode Command Set (alphabetical) (cont.)

"KB"	! Cal Factor
"KB99EN"	! enter 99% cal factor (preceed with AE or BE) ..... (page 4-6)
"LG"	! set Log units (dB or dBm) ..... (page 4-43)
"LH"	! High limit ..... (page 4-22)
"LH21.35EN"	! set high limit to +21.35 dBm ..... (page 4-22)
"LL"	! Low limit ..... (page 4-22)
"LL-12.15EN"	! set low limit to -12.15 dBm ..... (page 4-22)
"LM0"	! disable limit checking ..... (page 4-22)
"LM1"	! enable limit checking ..... (page 4-22)
"LN"	! set linear units (Watts or %) ..... (page 4-43)
"LP1"	! set learn mode #1 ..... (page 4-19)
"LP2"	! set learn mode #2 ..... (page 4-21)
"OC0"	! turn off calibrator source ..... (page 4-14)
"OC1"	! turn on calibrator source ..... (page 4-14)
"OS"	! OFFSET
"OS20.00EN"	! set +20 dB offset to (preceed with AE or BE) ..... (page 4-14)
"PR"	! preset the instrument to a known state ..... (page 4-17)
"RA"	! resume autorange
"*RC"	! RECALL
"RC0EN"	! recall previous instrument state ..... (page 4-37)
"RC3EN"	! recall instrument state in register 3 ..... (page 4-37)
"RH"	! do a range hold ..... **Not Supported**
"RL0"	! turn off rel mode ..... (page 4-31)
"RL1"	! turn on rel mode ..... (page 4-31)
"RM1EN"	! set manual range 1 ..... **Not Supported**
"RM2EN"	! set manual range 2 ..... **Not Supported**
"RM3EN"	! set manual range 3 ..... **Not Supported**
"RM4EN"	! set manual range 4 ..... **Not Supported**
"RM5EN"	! set manual range 5 ..... **Not Supported**
"RV"	! ask for status request mask ..... (page 4-33)
"SM"	! ask for status message ..... (page 4-34)
"ST"	! STORE ..... (page 4-37)
"ST12EN"	! store instrument state in register 12 ..... (page 4-37)
"TR0"	! Trigger hold mode ..... (page 4-42)
"TR1"	! Trigger single measurement ..... (page 4-42)
"TR2"	! Trigger full measurement with settling ..... (page 4-42)
"TR3"	! Free run trigger mode ..... (page 4-42)
"ZE"	! Zero sensor (preceed with AE or BE) ..... (page 4-46)

* Codes preceded by an asterisk (*) require a numeric entry followed by the "EN" program code. Do not enter the asterisk as part of the program code.

436 Emulation Command Set

(These are the GPIB commands available when the instrument is placed in the 436 emulation mode)

"5"	! set range 5
"4"	! set range 4
"3	! set range 3
"2	! set range 2
"1	! set range 1
"9	! set auto range
"A"	! set linear units (Watts)
"B"	! set relative mode
"C"	! set relative value
"D"	! set Log units (dBm)
"Z"	! zero sensor
"+"	! enable cal factors
"-"	! disable cal factors (ignored)
"H"	! set TR0 mode
"T"	! set TR2 mode
"I"	! set TR1 mode
"R"	! set TR3 mode
"V"	! set TR3 mode

CHAPTER 5

SPECIFICATION AND PERFORMANCE VERIFICATION TESTS

GENERAL

Information in this section is useful for periodic evaluation of the 8541 and 8542 (8541/2) Universal Power Meters and their power sensors. These tests can also be used for incoming inspection testing when the instrument is first received, if required.

If the 8541/2 Power Meter has not previously been used, Chapter 2 of this Manual should be reviewed to ensure that the instructions covering power requirements and GPIB address selection, for example, have been complied with before the instrument is turned on. Prior to starting the following procedures, the instrument should be allowed to warm up for at least 24 hours to assure maximum stability during testing.

The Specification Test for the Calibrator Output Power Reference Level given in this section is valid for an ambient temperature range between +15°C and +35°C.

The instrument plus power sensor linearity test is valid when the sensor has been calibrated using the front panel calibrator at a temperature between 0°C and +50°C, and if operating within ±5°C of that calibration temperature.

It is recommended that the verification be done in the order described since some of the steps use the configuration from a previous step.

EQUIPMENT REQUIRED

Description	Representative Model	Key Characteristics
CW Thermistor Power Meter	HP 432A	V_{RF} and V_{COMP} available externally
Thermistor Mount	HP 478A-H75	≤1.07 VSWR @ 50 MHz (30 dB return loss) Accuracy ±0.5% @ 50 MHz
Digital Voltmeter (DVM)	Fluke 8842A	±0.05% accuracy & 1 µV resolution
Directional Coupler, 10 dB	Mini Circuits ZFDC-10-1 10 dB	≤1.15 SWR @ 50 MHz
Step Attenuator, 0 to 90 dB in 10 dB increments	Weinshel Model AC 118A-90-33	≤1.15 SWR @ 50 MHz ±0.1 dB attenuation
RF Source (Signal Generator) (High Power)	Wavetek Model 2405 Option XP	+22 dBm @ 50 MHz
Low Pass Filter	Integrated Microwave Model 904 881	>30 dB attenuation @ 100 MHz
GPIB Controller	IBM PC	National GPIB Card or equivalent

Performance Verification Test Data Recording sheets are located starting on page 5-9. These sheets can be copied, and the copies used for recording test results each time Specification and Performance Verification testing is performed on this instrument.

TEST PROCEDURES

Calibrator Output Power Reference Level

The Calibrator Output power reference is factory adjusted to 1 mW ±0.7%. To achieve this accuracy, Giga-tronics uses a precision measurement system with accuracy to ±0.5% (traceable to the NIST - formerly the NBS), and allows for a transfer error of ±0.2% for a total of ±0.7%. If an equivalent measurement system is used for verification, the power reference oscillator output can be verified to 1mW ±1.9% (±1.2% accuracy + ±0.5% verification system error + ±0.2% transfer error = ±1.9% maximum error). To ensure maximum accuracy in verifying the Calibrator Output power reference, the following procedure provides step-by-step instructions for using specified test instruments of known capability. If equivalent test instruments are substituted, refer to the Key Characteristics section in the table of Equipment Required on the preceding page.

Figure 5-1, below, can be used as a guide for assembling the test setup.

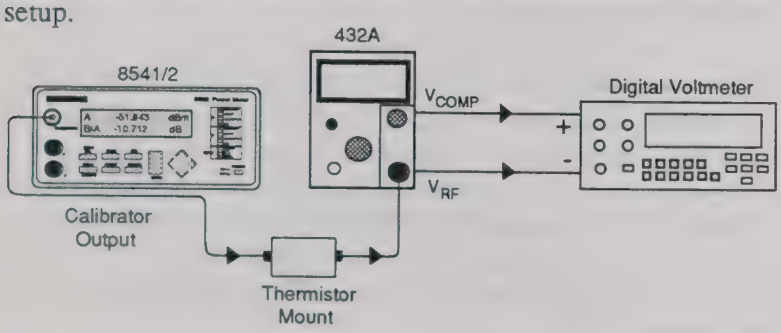


Figure 5-1. Calibrator Output Power Reference Level Test Setup

PROCEDURE

In the following steps, precision power measurements will be made using the 432A Power Meter. For detailed information on using the 432A, please refer to the operating section of the 432A manual.

1. Connect the 432A to the Calibrator Output on the 8541/2 as shown in Figure 5-1.

2. Turn on all equipment and then wait 30 minutes for the thermistor mount to stabilize before proceding to the next step.

3. Set the 432A RANGE switch to COARSE ZERO, and adjust the front panel COARSE ZERO control to obtain a zero (±2% F.S.) meter indication.

NOTE: Ensure that the DVM input leads are isolated from chassis ground when performing the next step.

4. Set the DVM to a range that results in a resolution of 1 μV and connect the positive and negative input, respectively, to the V_{COMP} and V_{RF} connectors on the rear panel of the 432A.

5. Fine zero the 432A on the most sensitive range, then set the 432A range switch to 1 mW.

6. Record the DVM indication as V_0.

7. Turn ON the 8541/2 Calibrator RF power as follows:

   Press **MENU,** scroll to *REF POWER ON/OFF*, press **ENTER**, select *ON*, press **ENTER.**
   Record the reading shown on the DVM as V_1.

   NOTE: The V_1 reading must be taken within 15 seconds after pressing ENTER. ***Otherwise, turn REF POWER OFF and repeat Steps 6 and 7.***

8. Disconnect the DVM negative lead from the V_{RF} connector on the 432A, and reconnect it to the 432A chassis ground. Record the new indication observed on the DVM as V_{COMP}.

9. Repeat Step 7, except select OFF to turn the Calibrator off.

10. Calculate the Calibrator Output level (P_{CAL}) using the following formula:

$$P_{CAL} = \frac{2V_{COMP}(V_1 - V_0) + V_0^2 - V_1^2}{4R\,(\text{CALIBRATION FACTOR})}$$

where:

P_{RF} = Calibrator Output power reference level
V_{COMP} = previously recorded value in Step 8
V_1 = previously recorded value in Step 7
V_0 = previously recorded value in Step 6
R = 200Ω (assuming HP478A-H75 mount)

CALIBRATION FACTOR = value for the thermistor mount at 50 MHz (traceable to NIST - formerly the National Bureau of Standards)

11. Verify that the P_{CAL} is within the following limits:

1 mW ±0.019 mW
(0.981 to 1.019 mW)

(For record purposes, the measured value of P_{CAL} can be entered on the Test Data Recording Sheet located on page 5-9.)

Instrument Plus Power Sensor Linearity

TEST DESCRIPTION

Connect the test setup as shown in Figure 5-2 on the next page. The linearity will be tested over the range +20 dBm to -60 dBm. At low power levels, the linearity measurement will include the uncertainty due to the zero set specification. The procedure should be repeated for each sensor used with the 8541/2.

When measuring the linearity of a Low VSWR (Model 8031X Series) or a High Power (Model 8032X Series) sensor, the power output of the source must be increased by 6 or 10 dB respectively and the directional coupler must be increased from 10 dB to either 16 or 20 dB respectively (see Figure 5-2). The power coefficient of the step attenuator will also have to be considered. The specification of power coefficient for the Weinchel attenuator cited in the Equipment List is: <0.005 dB/dB/W. The latter will effect the linearity of each 10 dB segment, and make it necessary to expand the overall linearity specification by this quantity.

In assembling the test setup shown in Figure 5-2, keep in mind that if testing is to be conducted with Low VSWR or High Power sensors, the optional RF Amplifier must have frequency and bandwidth to match the sensor's characteristics (see page 1-6, Sensor Selection Guide, if unsure of characteristics), and the Directional Coupler must be increased as stated above for the particular series of sensors. All Standard (Model 8030X) and True RMS (Model 8033X) sensors are tested without the optional RF Amplifier, and with a 10 dB Directional Coupler.

Refer to the Linearity Data recording section of the Performance Verification Data recording sheets located on pages 5-9 and 5-10. The tolerance is already entered for the various steps, and includes an allowance for specified zero set errors at low power levels.

To ensure accurate and repeatable measurements, the 432A power meter should be zeroed just before taking each reading that will be used to calculate "P1" in the Power Meter column of the Performance Verification Test Data Sheets on pages 5-9 and 5-10.

SETUP PARAMETERS

The following setup parameters should be accomplished prior to performing the Power Linearity test:

A. The 8541/2 and sensor should be calibrated by following the instructions starting on page 2 of the separate **MEASUREMENTS GUIDE** publication that came with this manual.

B. The Averaging is set to AUTO by entering the key sequence:

MENU —> *AVERAGE* —> **ENTER** —> *AUTO* —> **ENTER**

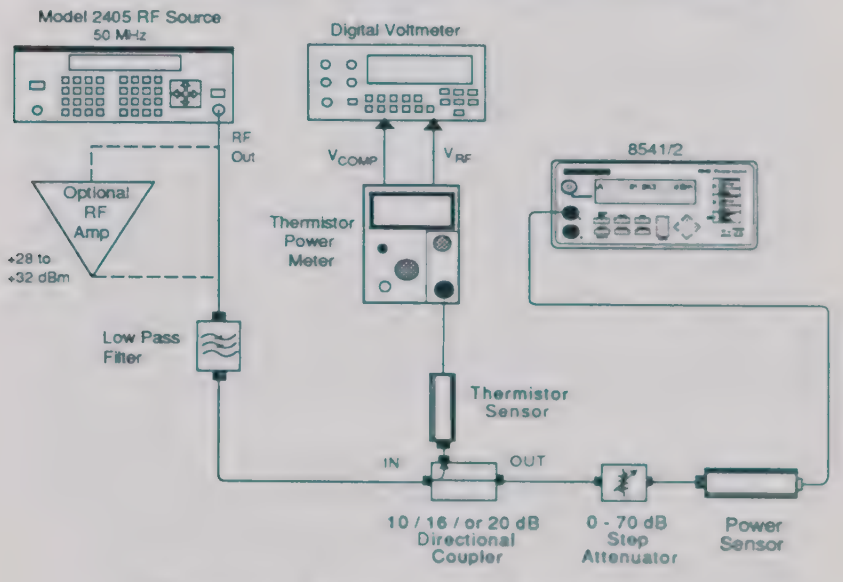


Figure 5-2. Power Linearity Test Setup

NOTE 1: Extreme care is required in the following procedure since the accuracy requirements are critical to ensure the most accurate test results.

NOTE 2: Power readings are determined using the thermistor power meter in the same general way as given in the Power Reference Level test. That is, "P1" and "P2" in the Power Meter reading column of the Performance Verification Test Data Sheet tables are calculated each time for the respective values of V_{COMP}, V_0, and V_1 read on the DVM.

TEST PROCEDURE

1. Set the step attenuater to 70 dB. Turn the source power output off, and then zero the 8541/2.

   (The 8541/2 is zeroed by pressing the **ZERO/CAL** key located on the front panel, and then following the softkey label instructions.)

2. Set the step attenuator to 0 dB after the 8541/2 has zeroed.

3. Set the power output of the RF source so that the thermistor power meter indicates 1.00 mW ±0.025 mW.

4. Record the calculated power meter reading and the displayed 8541/2 reading in the correct columns of the Linearity Data recording sheet on page 5-9.

5. Set the power output of the RF source so that the thermistor power meter indicates 3.98 mW ±0.10 mW.

6. Record the new calculated power meter reading and the new displayed 8541/2 reading as in Step 4, above.

7. Set the power output of the RF Source so that the thermistor power meter indicates 3.98 mW ± 0.10 mW.

8. Record the calculated power meter reading and the displayed 8541/2 reading as in Step 4, above.

9. Set the power output of the RF Source so that the thermistor power meter indicates 5.01 mW ± 0.13 mW,

10. Record the new calculated power meter reading and the new displayed 8541/2 reading as in Step 4, above.

11. Repeat using the power meter indications in the Data Recording sheet on page 5-10. Note that the Step Attenuator is used to generate the remaining 70 dB range of 10 dB steps for a total range of 80 dB. Repeat Step 1, above, between each 10 dB step shown on the Linearity Data Recording sheet.

12. Make the calculations indicated on the Linearity Data sheet, and enter the values in the appropriate blank spaces.

GPIB Port Check

The following steps are used to confirm that the GPIB port is functional.

1. Set the 8541/2 to the desired address (default is 13). (See page 2-3 of Chapter 2 for address setting instructions if necessary.)

2. Connect the GPIB controller to the GPIB Port on the rear of the 8541/2.

3. Send the command:

   *IDN? or ?ID (if emulating an HP 438)

   The first verb is the standardized COMMON identify query command as defined by IEEE 488.2 1988. When talk addressed after receiving the command, the 8541/2 will output a string that identifies itself as the 8541 or 8542 Digital Power Meter.

4. Display the response on the controller.

This completes the Specification and Performance Verification Tests for the 8540 Series Digital Power Meter and its sensors. If the instrument has performed as described in this chapter, it is correctly calibrated and within specifications.

GIGA-TRONICS 8540 SERIES PERFORMANCE VERIFICATION TEST DATA SHEET

Date: _____ Model 8541/2 S/N: _____

Operator: _____ Power Sensor S/N: _____

Test Number: _____ (if required)

Calibrator Output Power Reference

Minimum	Actual Reading	Maximum
0.981 mW		1.019 mW

Linearity Data - (+16 dBm to +20 dBm)

Step Attenuator Value	Power Set Point	Power Meter Reading (P)	8540 (DUT) Reading (R)	Reference Power Ratio	8540 (DUT) Reading Ratio	[1] Linearity Error (%)	
						Linearity Specification	[2] Accumulated Linearity Error
0 dB	1.00 mW ±0.025 mW	P1 =	R1 =	P1/P2 =	R1/R2 =		
	3.98 mW ±0.10 mW	P2 =	R2 =			±1%	*Same as Lin. error above*
0 dB	3.98 mW ±0.10 mW	P1 =	R1 =	P1/P2 =	R1/R2 =		
	5.01 mW ±0.13 mW	P2 =	R2 =			+1% -1.37%	
0 dB	5.01 mW ±0.13 mW	P1 =	R1 =	P1/P2 =	R1/R2 =		
	6.31 mW ±0.16 mW	P2 =	R2 =			+1% -1.83%	
0 dB	6.31 mW ±0.16 mW	P1 =	R1 =	P1/P2 =	R1/R2 =		
	7.94 mW ±0.2 mW	P2 =	R2 =			+1% -2.28%	
0 dB	7.94 mW ±0.2 mW	P1 =	R1 =	P1/P2 =	R1/R2 =		
	10 mW ±0.25 mW	P2 =	R2 =			+1% -2.73%	

(continued on next page)

[1] Linearity Error (%) = [(R1/R2) / (P1/P2) - 1] * 100

[2] Accumulated error is the sum of the current dB segment linearity error plus the previous accumulated error.

Linearity Data - (+16 dBm to -60 dBm)

Step Attenuator Value	Power Set Point	Power Meter Reading (P)	8540 (DUT) Reading (R)	Reference Power Ratio	8540 (DUT) Reading Ratio	[1] Linearity Error (%)	
						Linearity Specification	[2] Accumulated Linearity Error
0 dB						[3] See Below	
						±1%	*Same as Lin. error above*
10 dB	1.00 mW ±0.025 mW	P1 =	R1 =	P1/P2 =	R1/R2 =		
	10.00 mW ±0.25 mW	P2 =	R2 =			±1%	
20 dB	1.00 mW ±0.025 mW	P1 =	R1 =	P1/P2 =	R1/R2 =		
	10.00 mW ±0.25 mW	P2 =	R2 =			±1%	
30 dB	1.00 mW ±0.025 mW	P1 =	R1 =	P1/P2 =	R1/R2 =		
	10.00 mW ±0.25 mW	P2 =	R2 =			±1%	
40 dB	1.00 mW ±0.025 mW	P1 =	R1 =	P1/P2 =	R1/R2 =		
	10.00 mW ±0.25 mW	P2 =	R2 =			±1%	
50 dB	1.00 mW ±0.025 mW	P1 =	R1 =	P1/P2 =	R1/R2 =		
	10.00 mW ±0.25 mW	P2 =	R2 =			±1%	
60 dB	1.00 mW ±0.025 mW	P1 =	R1 =	P1/P2 =	R1/R2 =		
	10.00 mW ±0.25 mW	P2 =	R2 =			±1.5%	
70 dB	1.00 mW ±0.025 mW	P1 =	R1 =	P1/P2 =	R1/R2 =		
	10.00 mW ±0.25 mW	P2 =	R2 =			±6%	

[1] Linearity Error (%) = [(R1/R2) / (P1/P2) - 1] * 100

[2] Accumulated error is the sum of the current dB segment linearity error plus the previous accumulated error

[3] Use the first CW Linearity error value entered in the +16 dBm to +20 dBm table on page 5-9.

CHAPTER 6

ELECTRICAL DESCRIPTION

GENERAL

This chapter of the 8540 Series Operating and Maintenance Manual contains a functional description of the electrical circuits contained on the PC boards and front and rear panel assemblies of the 8540 Series Power Meters. Table 6-A, below, lists the various circuit assemblies by their reference designations, and includes the Schematic Diagram (SD) and assembly part number for each board.

Table 6-A. 8540 Series Circuit Assemblies

Reference Designation	Nomenclature	Assembly No.	SD No.[1]
A1	CPU PC Bd Assembly	21095	21096
A2	Analog PC Bd Assembly	21181	21182
A3	Front Panel PC Bd Assembly	21229	21230
A4	LCD Display Assembly	21240	21246

[1] "SD" stands for Schematic Diagram

System Description

(See SD 21246 on page 8-3 for specific interconnect information.)

The 8540 Series Power Meters electrical circuitry resides mainly on two PC boards; the CPU PC Board (A1) and the Analog PC Board (A2). The CPU board interfaces with the Analog PC board through connection A1J1/A2P1. The CPU also connects to the Front Panel PC Board that provides the keyboard interface, and to the LED status indicators and LCD display assembly.

Various cables interface to the meter through the BNC and GPIB connections located on the rear panel. The GPIB connector goes to the CPU board through connector J3. Three rear panel BNCs connect to the CPU board, and two rear panel BNCs go to the Analog board. J8 on the CPU assembly is used for in-house development and testing.

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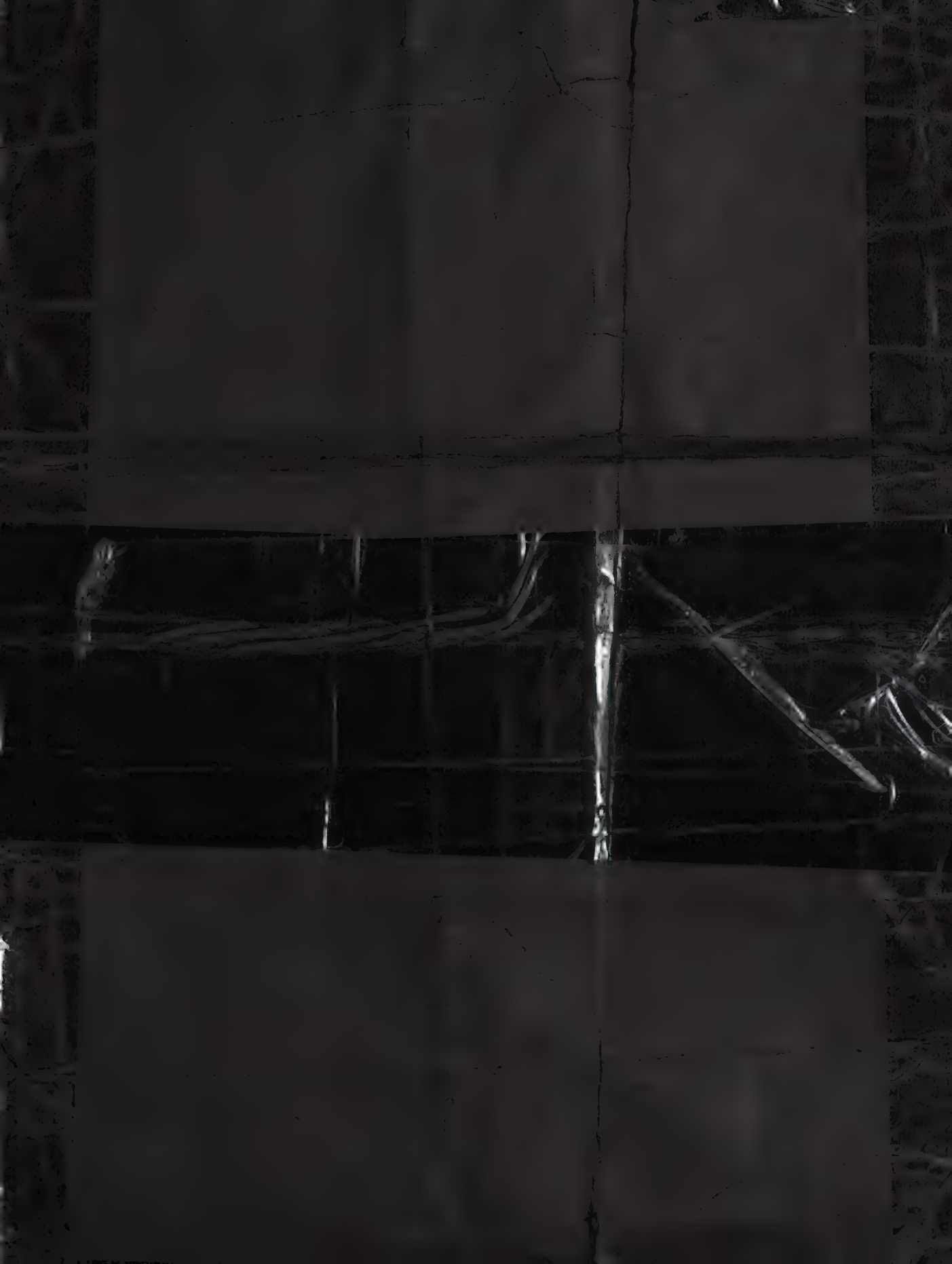

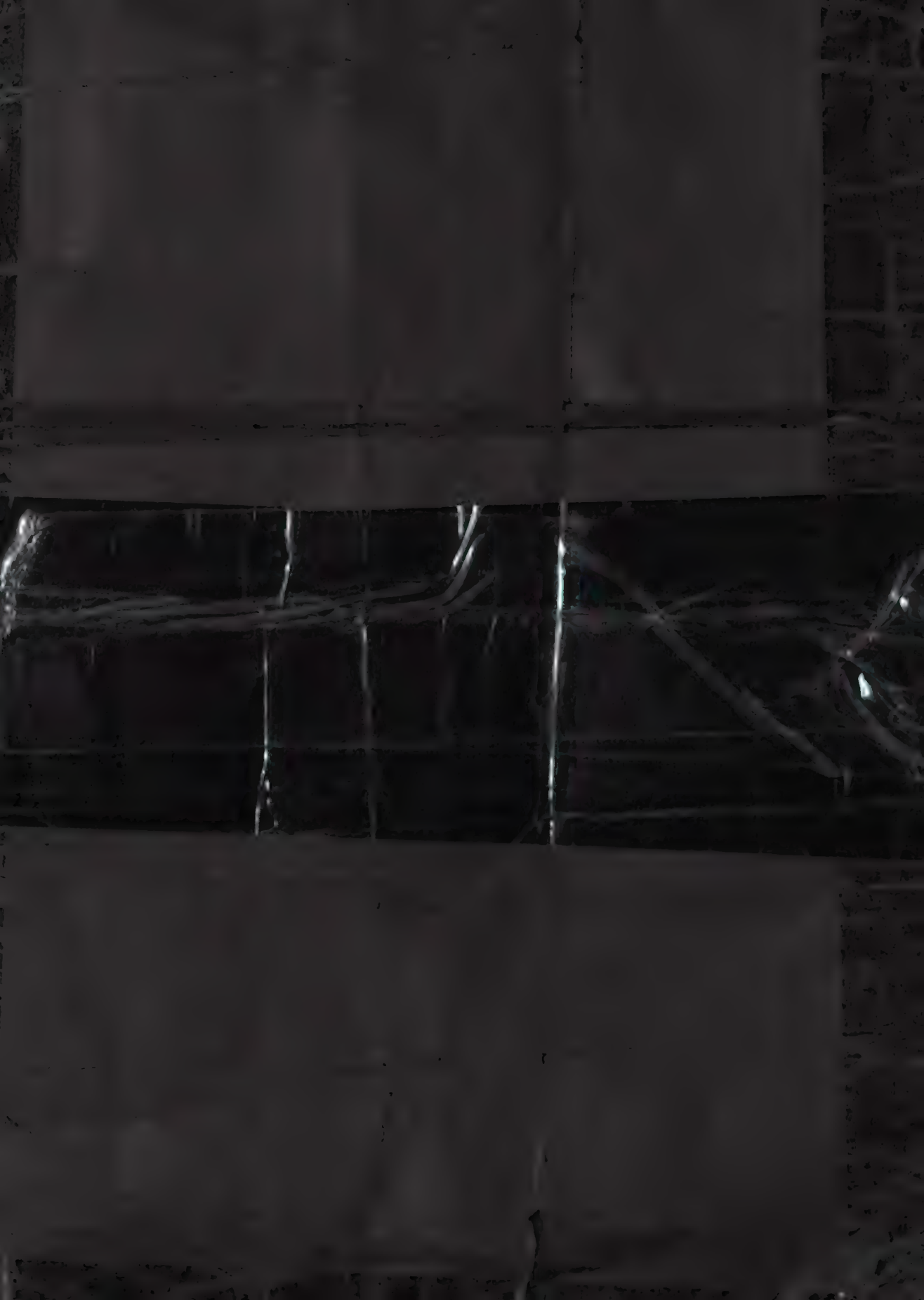

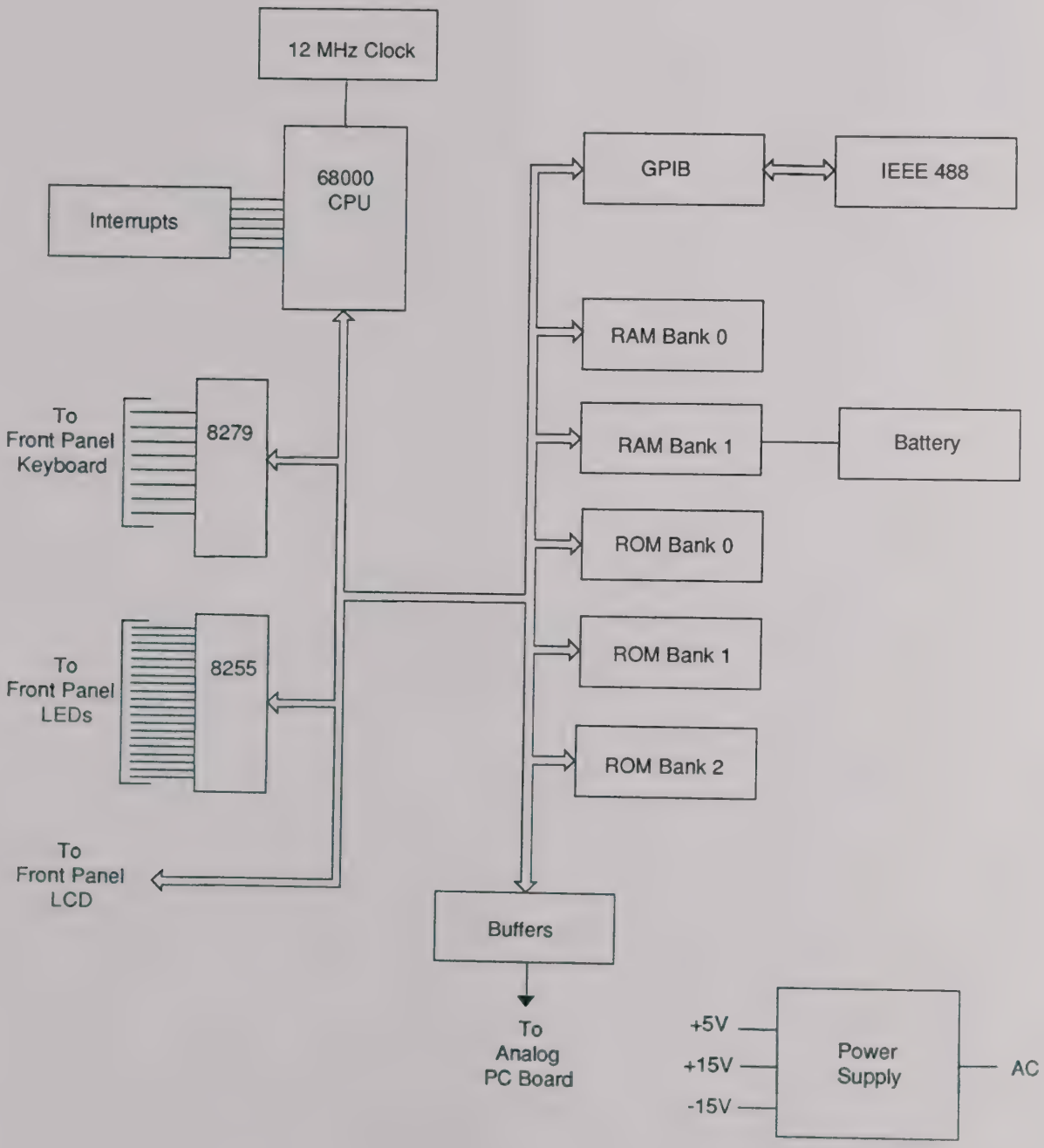

Figure 6-1. CPU PC Board Assembly (A1) Block Diagram

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CPU PC Board (A1)

(Refer to Figure 6-1 on page 6-3 and SD 21096 starting on page 8-7)

POWER SUPPLY

As shown on Sheet 2 of SD 21246 on page 8-5, AC mains power (110 or 220V) is applied to transformer T1. T1 outputs a 10VAC signal and two 19VAC signals which are supplied to the DC power supply on the CPU board.

The DC power supply used to produce the +5VDC and +15/ -15VDC required by the various circuits in the meter is shown on Sheet 3 of SD 21096, page 8-11.

The T1 transformer's 10VAC and 19VAC enters the DC supply through J9. CR6 rectifies the 10VAC to an unregulated 8VDC. C54 and C6 provide filtering, and the unregulated voltage is applied to regulators U37 and U36. The U37 regulator is used to supply the 5V (at 0.5A) required by the front panel LCD display's backlight. U38 supplies the 5V required by all of the digital circuitry. TP12 and TP13 are available to test the level of the 5V supply. CR7 rectifies the unregulated voltage of the +19/-19V filters which is applied to U39 and U40 through C9 and C12. U39 is the +15V regulator, and U40 is the -15V regulator. TP14 and TP15 are available to test these voltages.

Battery Back-Up

A 3.6V lithium battery is used for non-volatile RAM backup for system configuration storage registers. TP16 & TP17 and R29 are used as a current draw monitor for the battery. If the battery is supplying too much current, it will be shown as the voltage drop across R29. Typically, the non-volatile RAMs should draw about 3 µA from the battery. This will produce 3 mV across TP16 & 17.

MAIN CPU BOARD CIRCUIT DESCRIPTION

Referring to Sheet 1 of SD 21906 on page 8-7, Y1 (shown in the upper left corner of Sheet 1) is a 24 MHz crystal oscillator that provides the main clock signals for the circuitry. U1A is a divide-by-two counter that outputs 12 MHz. This 12 MHz is used by the 68000 microprocessor, U9, so that U9 is running at a 12 MHz clock speed. The clock is further divided down for other uses at U2-6 - which provides frequencies of 6 MHz, 3 MHz, 1.5 MHz, and 0.75 MHz. U2-9 provides wait states when accessing peripherals. U17D/E/F and U16C&D provide U9 with decoding of the status lines for auto vector interrupts. U16A provides an upper data byte write signal, and U16B furnishes the lower data byte write signal.

The 68000 microprocessor (U9) is a 16 bit component with a high 8 bits and a low 8 bits. Most 8 bit peripherals operate using the low 8 bits with only those devices requiring more than 8 bits using the high 8 bit data. (e.g. the ROM and RAM use both upper and lower.)

U4 is a PAL (Programmable Logic Device) that provides address decoding for RAM Banks 0 and 1, and ROM banks 0, 1, and 2. U4 pin 15 is a chip select for all peripherals. The signal from U4 goes to U18 which further decodes address signals into various port chip selects. The U4 and U2 ICs provide the wait state function When U4 decodes ROM or RAM it immediately passes back DTAK via pin 12 to U9. When it encounters a peripheral device address (when pin 15 is low for the chip select), DTAK is held off until a signal is received on pin 1. The pin 1 signal comes from the wait state generation of U2. The sequence is: The address strobe comes on, U4 looks at the address lines and detects that it is a peripheral being addressed, and the chip select from U4 pin 15 goes to pin 2 of U2. U2A then starts counting down until pin 6 comes true (through jumper D) which happens 8 clock cycles later (a wait state of 8). The signal gets passed to pin 1, and then U4 passes DTAK (pin 12) to the U9 processor. By this method, various wait states can be generated with jumpers A, B, C, and D (1, 2, 3, and 4 wait states). (ROM and RAM are always 0 wait states so DTAK passes right through.)

The RAM 1 chip select is passed through U10 which is a non-volatile RAM controller. This chip will only chip select to pass through from pin 5 to pin 6 if pin 8 has a valid 5V of power supplied to it. When the power supply is off and pin 8 no longer has 5V applied to it, U10 will automatically stop chip selects from passing through. It automatically routes pin 2's power (instead of routing pin 8's power) from the backup battery to pin 1 which is the battery voltage for RAM Bank 1. This means that when power is turned off, no memory is lost and chip select is disabled to stop any memory writes from occuring that could corrupt the data.

U22 provides the reset for the processor, U9. When the power is turned on U9 asserts the reset line, pin 5, for 250 ms. That signal is buffered by U20A&B (open collector drivers) that cause the reset of U9. When U9 is reset it re-asserts pin 18, buffered by U17A, which provides the reset signal. This can be tested at TP8.

R2 and R3 divide down the unregulated supply voltage and provide pin 1 of U22 with a threshold voltage. When the power

supply is been turned off, U22 will detect this by seeing a voltage change in the pin 1 voltage. When the voltage drops, it will assert the interrupt, pin 7 of U22. This tells U9 that the power is being turned off, and that it should complete any current operations before the power is removed.

U21 provides encoding of the interrupt signals by an 8 line to 3 line encoding routine. Interrupt 0 is not used. Interrupts 1 through 7 can be enabled or disabled by removing or replacing jumpers A through G. Jumper H disables all interrupts so that it is not necessary to remove A through G if this is desired. Interrupt 1 occurs when a sensor is connected or disconnected. Interrupt 2 is used with the rear panel BNC trigger. Interrupt 3 occurs when any GPIB bus activity is in progress. Interrupt 4 occurs when a front panel key is depressed, and interrupts 5 and 6 are available for programmable timing provided by U26 (currently not used). Interrupt 7 is used when the power supply is shut down.

U26 is one of three programmable timers used in the system. These timers divide down the supply clock, clock 0, 1, and 2, which are all 0.75 MHz clocks that can be programmably divided down to provide different clock signals. Presently, U26 is not used (for future development).

U8 (a Texas Instrument 9914 GPIB controller chip) is a peripheral chip used for GPIB affectivity. U6 and U7 provide buffering of GPIB signals before they are sent out over the bus. Pin 1 of U7 programs the GPIB bus to be a master controller or a talker/listener device. Presently, only talker/listener modes are used in the 8540 Series meters. U23 is an 8279 keyboard controller that provides keyboard scanning and keypress detection. It also provides an 8 key buffer. U19 is a 3 to 8 line decoder used for column and row scanning which are detected by pins 1, 2, 38, 39, and U23. When U23 detects a key press, it asserts interrupt 4 from U24A. U22, U23, U24, and U25 provide pull ups for the keyboard matrix. U25 is a PIA (Peripheral Interface Adapter) used to program the 20 front panel LEDs.

Pin 10 of U25 provides drive for the single LED on the CPU board, DS1, that is used for internal testing. Pins 11, 12, and 13 are auxiliary signals which are presently not used. The battery interfaces with U27 and U28. Each of these devices typically draw 1 μA, for a total battery dissipation of approximately 3 μA.

There are additional signals present at U3. Pin 4 drives Q1 which, in turn, drives a piezo-electric beeper for front panel audio signals. Pin 3 of U3 resets the trigger latch, U1B. Pin 2 is an output buffered by U24E which is the RF blanking signal used to turn off the source RF during zeroing. This is done automatically through J7. Pin 18 is is the trigger latch input from U1B. The normal sequence of operation for the external trigger signal is: The trigger input signal is applied through the TRIGGER INPUT BNC connector, J4, on the rear panel. R11, R12, CR2 and CR13 provide input protection for U24B which buffers the trigger signal and acts as a schmitt trigger. The trigger can either assert Interrupt 2 to provide edge detection, or be latched by U1B for level detection. U1B can be set by asserting pin 13, and then unasserting pin 13 which sets the latch ready for a new trigger signal which is read by pin 9. U3, pin 19, is an input from U24D which is for future use. R11, R14, CR4 and CR 5 also provide input protection.

The CPU Board connects to the Analog Board via J1. Bus signals are buffered by U12 and U13 which are bi-directional devices that buffer the 16 data lines, D0 - D15. These tri-state buffers are only active when the Analog Board is chip selected via CS Analog (pin 12 of U18). All 16 data lines are sent to the Analog Board, but only 4 addresses (A0 - A3) are buffered by U14A. Reset, not read/write, read/not write, and the lower data write signals are also buffered.

The Chip Select Analog is further decoded into 8 additional chip selects for the Analog Board by U15 which then outputs ACS0 through ACS1.

Referring to Sheet 2 of SD 21096 on page 8-9. the DIP sockets that the ROMs and RAMs are mounted in are configured to accept either 512k or 1000k devices. 512k devices are 28 pin components that have to go into 32 pin sockets. When this is done, pins 1, 2, 31, and 32 are not used which means that the 512k device is occupying pins 3 through 30 of the socket. The difference in address decoding between 512k and 1000k devices is provided by PAL U4.

The ROM and RAM banks are word addressed. The necessary reads and writes are done in 16 bit words. Each chip in the bank provides 8 bits (or 1/2 of the word). For example, ROM Bank 0 is composed of U35 and U36. U35 is the lower 8 bits, and U36 is the upper 8 bits of data. U33 and U34 are ROM Bank 1, and U31 and U32 are ROM Bank 2.

RAM Bank 0 is only loaded if Option 02 (128k Buffer) is specified. This option provides more memory buffer for the Burst and Swift Modes. RAM Bank 0 is volatile RAM (losses memory when power is turned off). RAM Bank 1 is composed of U27 and U28 which are non-volatile because they are connected to the backup battery.

Connection J6 interfaces the LCD display with the CPU Board. R26, R27, and R28 provide current limiting for the LED backlight of the display (draws approximately 1/2 Amp). The resistor divider network, R16, is used to provide contrast adjustment for the LCD display, and U11B buffered by U24F provide a decoded data strobe.

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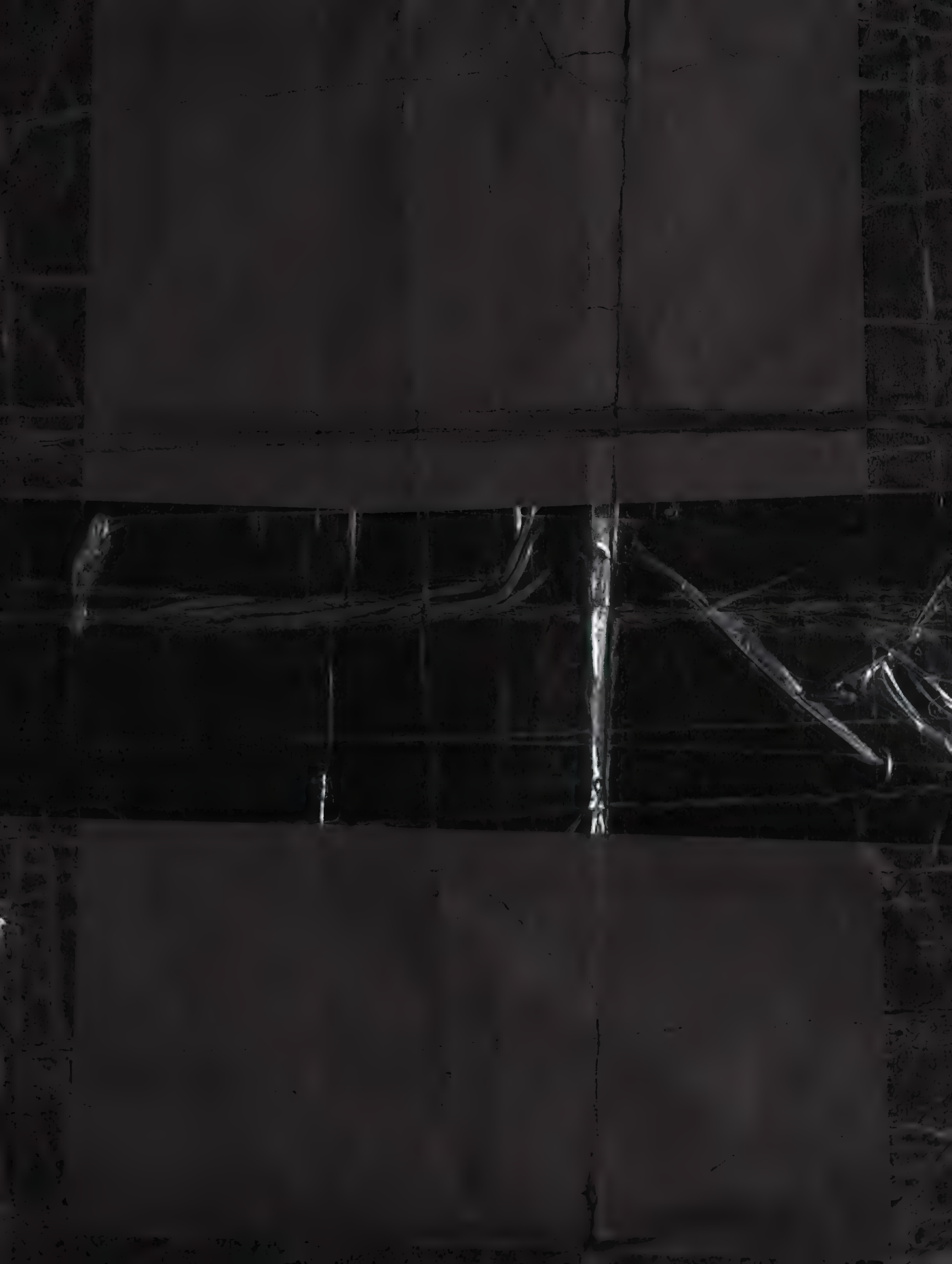

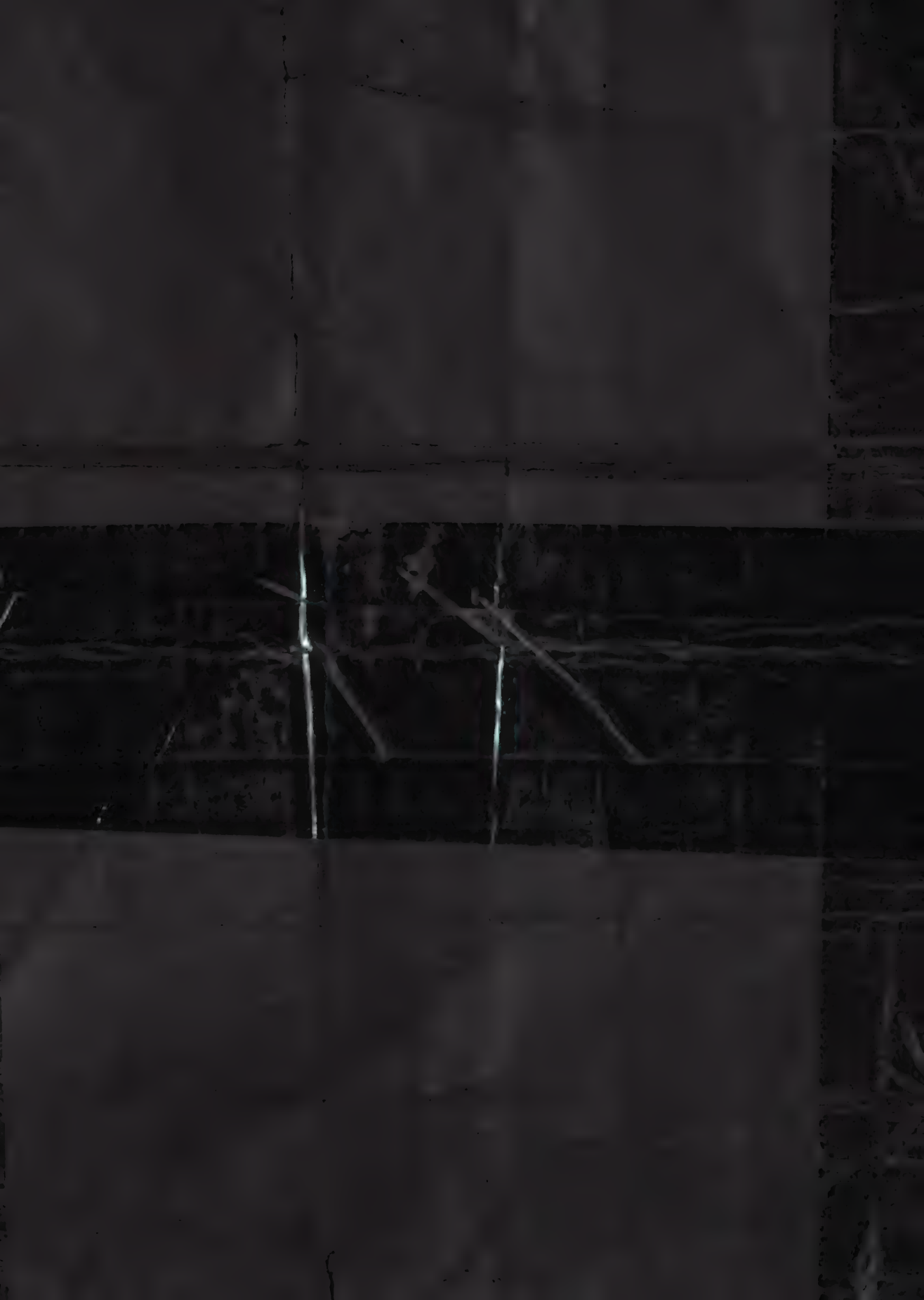

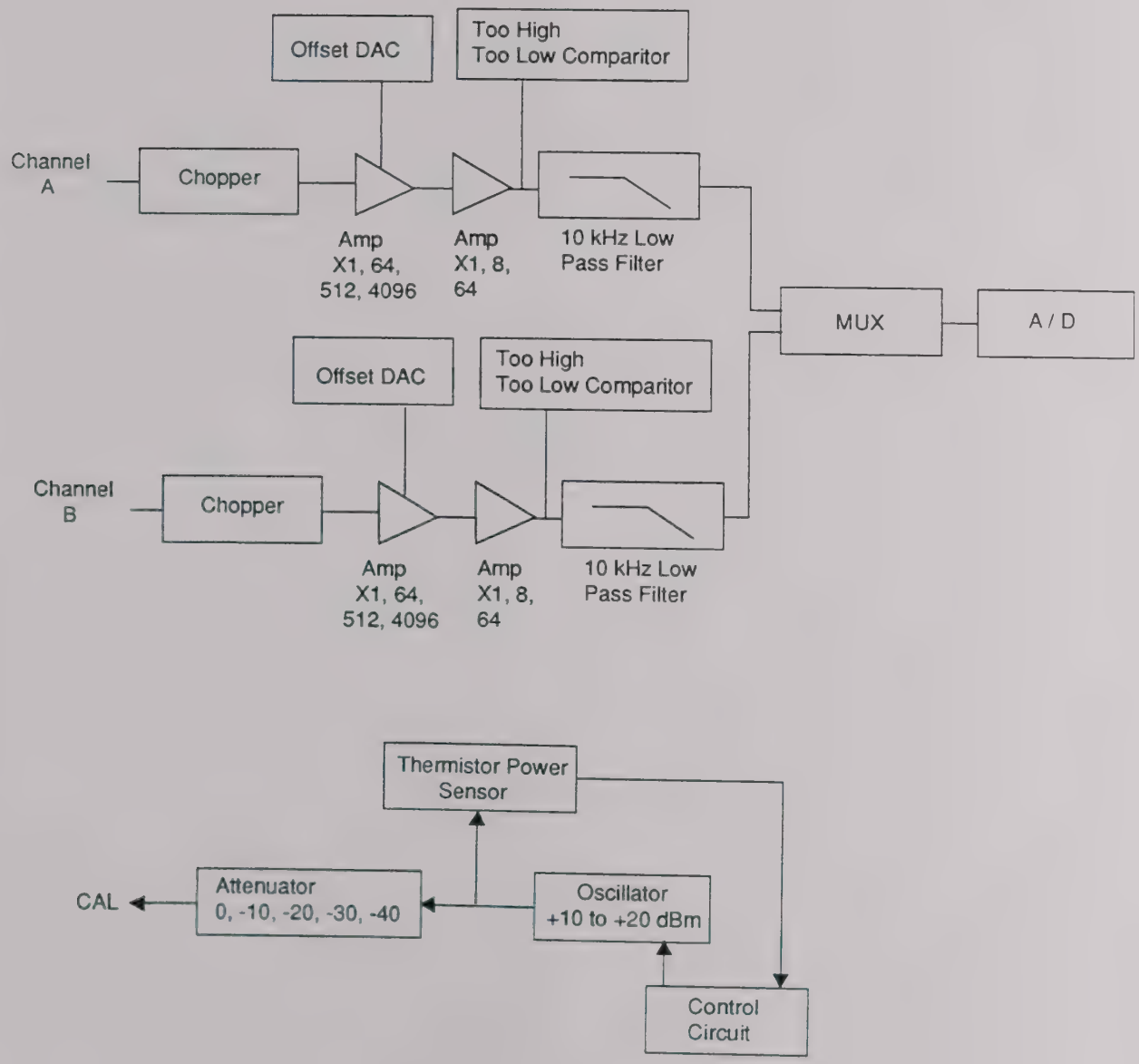

Figure 6-2. Analog PC Board Assembly (A2) Block Diagram

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Analog PC Board (A2)

(Refer to Figure 6-2 on page 6-11 and SD 21182 starting on page 8-13)

Sheet 1 of SD 21182 on page 8-13 shows the Channel A sensor amplifier circuitry (used with both the 8541 and 8542 instruments), and Sheet 2 on page 8-15 covers the Channel B sensor amplifier circuits (used only with the 8542 instrument). Since these are essentially duplicate circuits (differences will be defined), this discussion will mainly focus on the Sheet 1 components. The sensors are connected from the front panel through W6J1 which enters the Analog Board through J1 for sensor A and J2 for sensor B. The detected DC voltage from the sensor is a differential voltage applied to pins 3 and 4 of J1. This differential voltage goes to U27 which is a FET chopping circuit. The outputs are pins 8 and 9 of U27. An incoming signal can either be fed straight through or inverted. The signal is fed straight through when A1 and A0 are both low. It is fed through in the inverted mode when A1 is low and A0 is high. When A0 is low and A1 is high the signal is shorted together and grounded, and when A0 and A1 are both high, the input is open (floating). This provides chopper stabilized amplification when low power signals are being received by switching the FET switch from the inverting to non-inverting mode and back again at a rate of 300 times per second.

U29 is the 1st stage amplifier, and has programmable gain. The programmable gain is provided by U28 and the resistor ladder composed of R6 through 12 which will program gains of 1, 64, 512, and 4096. U30A is the 2nd stage amplifier that provides programmed gains of 1, 8, and 64 using FET switch U31 and resistor ladder R16, R17, and R18. C168, C167, R13, and R14 (though shown on the schematic) are not loaded on the board.

U30B/C/D and associated components provide a 6 pole bessel filter in the low pass configuration - 10 kHz with a 120 µs settling time. In normal operation, the signal will always go through this filter. Other paths such as unfiltered A, TP8, and 1st amp signals are provided for testing only and not used in normal operation.

The 1st amplifier, U29, has an offset voltage injected into it via pin 7. This offset voltage comes from the 12 bit DAC, (U20 for channel A and U17 for channel B). Offset voltages range from +5V to -5V which can effectively remove about a ±1.2 mV offset at the detector. U32A&B are comparitors which monitor the input signal for a too high or too low condition. The too low comparitor,

U32B, will fire if the voltage is below 1V, and the too high comparitor, U32A will fire if the voltage is above 9V. This provides an A/D conversion range of 1 to 9V. The too high and too low signals are used by the software to determine whether or not a range change should be made. There are 7 ranges. Four ranges are processed by U29 (1st Amp), and three ranges by U30A. Appropriate gains are set to keep voltages at the A/D conversion point between 1V and 9V. R45 and R46, divide the 12V regulated voltage to 1V such that the too low comparitor will fire below 1V to assert the too low signal. R36 and R37, divide the 12V signal to 3V, and R40 and R41 divide the incoming signal by 3 so that the too high comparitor will always fire at 9V.

Refer to Sheet 2 (Channel B) of SD 21182 on page 8-15 which is exactly the same as Channel A on the top 1/2 of the sheet (with different component numbers). The too high and too low comparitors are separate, but function just like the A channel comparitors.

Each detector has a thermistor included in its housing so that the power meter can read the temperature of the sensor. The voltage from that thermistor is applied through J1-6 (for channel A) and amplified by a gain of 2 by U39A (shown on Sheet 1). Channel B sensor's thermistor voltage comes in through J2-6 and is amplified by 2 at U39C. The thermistor voltages are also routed to U39D and U40A&B. This circuit is used to detect whether a sensor has been attached or disconnected. The connection or disconnection of a sensor causes a transient voltage which is passed through C10 (for channel A) or C11 (for channel B). This is detected by a window comparitor consisting of U39A and U40A&B. Whenever the voltage is outside the normal DC bias range, the detector change will cause either a rise or a fall in the voltage that will be detected by the comparitor. The comparitor will output an interrupt to the U9 processor, IRQ, which will be the output of U40A&B.

U10A and U9A provide an enable or disable interrupt circuit so that the processor can disable interrupts. Pin 2 of U9A is used to enable or disable interrupts. U40C buffers the interrupt signal, and will allow the interrupt to either pass through or not pass through depending on the state of U9A. The interrupt 1 signal goes to the CPU Board.

The sensors also have EEPROMs that connect to the system through a serial interface. Channel A uses J1-13 for the clock and J1-12 for the data. This is a bi-directional device wherein data

needs to be written to the sensor and also read to the sensor. U14B buffers incoming data, and U41C buffers outgoing data. Q1 provides the necessary open collector interface. U18 supplies the clock during a read or write action. The clock signal is buffered by U41A. Channel B has a duplicate circuit consisting of U41D/E/F and Q3. DC supplies of +5V and ±15V are also routed to the sensors.. The 15V supplies are routed through RT3 and RT4 which are used to provide solid state fusing in case of any shorts. These are resettable solid state fuses which do not need to be replaced. The +5V can be switched on and off. This is buffered by Q8 which can enable or disable Q1, and is solid state fused by RT1.

Refer to Sheet 3 of SD 21182 on page 8-17. To recap the preliminary actions of the incoming signals; they first go through the chopper, the 1st stage amplifier, the 2nd stage amplifier, and then the filter. The signals are then sent to U36, a 16 to 1 multiplexer. U36 can select 1 signal to route to U33, the A to D convertor. Most of the other signals are used for testing purposes only. During normal operation, the signal path will be through the other bessel filter. Channel A will enter through pin 11 of U36, and channel B will enter pin 19 of U36. (This is the path for measuring power.)

Thermistor voltages come in on pins 24 and 25 for channels A and B. The only other signal that is used for normal operation is the V prop. F input that comes in through the J3 BNC on the rear panel. CR15 provides input protection, and U38A is a x1 amplifier/ buffer. The V prop F signal can be read at pin 26 of the multiplexer. U33 is a 14 bit A/D which operates at an 11 µs conversion time. The input is via pin 6 on TP13, and this device can measure between 0 and 10V. U33s operating power supplies are limited to ±12V (pins 11 and 5). Those voltages are derived from ICs U35 and U34 which regulate the ±15V to ±12V.

R105, R104, and C31 configure U33 to measure unipolar operation at 0 to 10V. U4 provides the start convert signal, and the U9 processor will assert this signal to start an A/D conversion. After the A to D conversion has completed, pin 3 can be asserted to output the data to the bus. These two functions are supplied by chip select ACS7 and ACS1. ACS1 is the output enable, and ACS7 is the start convert. EOC is end of convert which occurs at pin 2 of U33. That is routed to data byte 15 so that the process can interrogate to see if the data conversion is complete. D15 will be asserted if the A/D has completed its conversion.

U20 is the offset D/A which provides the 1st stage amplifier (Channel A) with ±5V offset voltages. U17 provides channel B with its ±5V offsets. These are 12 bit D/A convertors. U37 is similar, but is configured for 0 to 10V. The output of U37 is buffered by U38B, current limited by R108, and is available at J4B&C for analog output.

U36 has a number of signals available for testing purposes. Offset voltages are available on pins 5 and 6. Output DAC voltage is available on pin 4, and switched 5V signals on pin 7.

Sheets 4 and 5 of SD 21182 on pages 8-19 and 8-21 cover the interconnections for the Calibrator circuitry and will be discussed starting on the next page, but U21 also serves the purpose of providing three 8-bit ports that are available for control of the multiplexers used in the Analog section, and an input port for the too high and too low comparators.

Calibrator Module

(Refer to SD 21182, Sheets 5 & 6 , on pages 8-19 & 8-21)

The Calibrator Module is located on the Analog PC Board. It is basically the heart of the 8540 Series Power Meters in that it is a patented system that allows the power sensors to be calibrated against an internal thermistor power standard (see Figure 6-3 below). In contrast to the conventional fixed-level calibrators, the 8540 calibrator produces a range of power levels over a 50 dB dynamic range to an accuracy of a few thousandths of a dB.

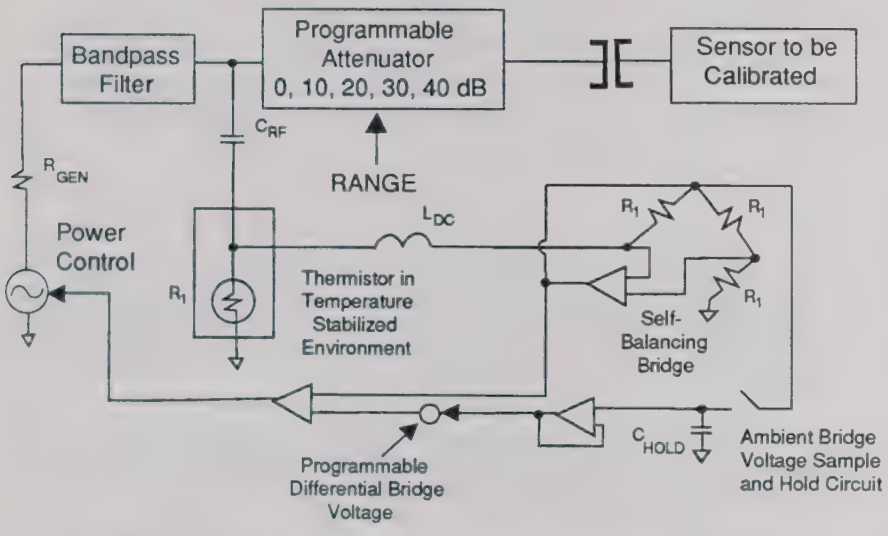

Figure 6-3. Calibrator Internal Power Standard Configuration

The thermistor is mounted in a self-balancing bridge configuration using DC substitution in the bridge. In this arrangement, the thermistor is maintained at a fixed operating point and the DC power in the thermistor, P_{DC}, is related to the RF power, P_{RF}, by the simple relationship:

$$P_{DC} + P_{RF} = P_{AMBIENT} = \text{constant}$$

The constant, $P_{AMBIENT}$, is found by turning the RF power off and measuring the ambient voltage, $V_{AMBIENT}$, to which the self-balancing bridge settles. The advantange of this approach is that the linearity of the thermistor-leveled oscillator is limited only by the accuracy with which DC voltages can be measured and the stability of the RF calibrator. To ensure exceptional stability, the thermistor assembly is enclosed in a temperature-stabilized environment and a

low drift sampling circuit is used to hold the ambient bridge voltage. The RF power can then be programmed by controlling a difference voltage, δV, at the summing node. The power is related to the voltage by:

$$P_{RF} = \frac{V_{AMBIENT}\,\delta V - \delta V^2}{R_1} - \frac{\delta V^2}{2R_1}$$

This permits the RF power to be precisely controlled over a dynamic range of about 12 to 15 dB. The dynamic range is extended using a switched attenuator, the properties of which are determined using the thermistor-leveled oscillator itself. The effective attenuation (including all mismatch effects) of each attenuator relative to the next is measured by finding a pair of powers, one for each attenuator, that produces identical signals from the sensor under test. Because the sensor under test is used at a fixed operating point, no knowledge of its detection law is required.

General

The operation of the various circuitry functions of the Calibrator Module can be understood more easily if the circuits are discussed individually. The 11 functional sections of this module include the following:

1. The 50 MHz oscillator, Q4, and its current control circuit consisting of U16D, Q5, and U2C.

2. The RF output circuit consisting of the low pass filter, the stepped attenuator, and the connector and cable to the front panel of the 8540 meter.

3. The oven that maintains the control thermistor at a constant 60°C which is located on the small board attached to the bottom of the heater transistor, Q1. The board has two thermistors, RT1 and RT2, and Q7, the control transistor.

4. The thermistor bridge used to measure the RF power by DC substitution, consisting of RT1, U1, and Q6.

5. The track and hold circuit that remembers the ambient bridge voltage, using U2B, U8D, and U3A.

6. The 14 bit DAC and reference supply used to measure the ambient bridge voltage and control the RF output level, made up of U11, U7, U8A & B, U6, U16A, U13, U12, U4, and U15.

7. The correction circuit used to measure the temperature of the PIN diode attenuator so that a correction for the temperature dependent loss of the diodes can be corrected, consisting of RT2 and U16C.

8. NV (Non-Volatile) RAM control circuit, U41D/E/F, Q3, and U18.

9. Calibrator NVRAM control circuit, U14 and U18.

10. Sensor interrupt control circuit, U9, U10A, U40A/B/C, and U39D.

11. The digital control circuit consisting of U18, U15B/C, U10B/C, U9B and U15A.

50 MHz Oscillator

The first section of the Calibrator Module Assembly circuitry consists of a colpits oscillator circuit with a controllable power output. The output power is measured by the thermistor bridge and set by varying the DC current through Q4. This current is supplied by a voltage to current converter circuit consisting of U16D, Q5, and U4. The power generated by Q4 is nearly linearly related to the current through it. Thus, the voltage from U4 that is converted to current by U16D and Q5 is linearly related to the RF power generated. When the calibrator is set for 0 dBm, the voltage at U4-6 is near 0 volts.

RF Output

The 50 MHz oscillator output is capacity coupled to the low pass filter, L13, L14, L15, and associated capacitors. The resultant harmonic-free RF is applied to the switched PIN attenuator, CR8 - 14, and associated resistors and control amplifiers U19 and U16B. The first section is 10 dB, the output section is 20 dB, and a resistor between sections adds another 10 dB. Thus, the output power can be programmed from +20 to -30 dBm.

Oven

The measuring thermistor is maintained at a constant 60°C by being mounted on the heater transistor, Q1, which is driven from the sensing thermistor RT2 by way of the current amplifier, Q7. RT2 is mounted very close to RT1 so that both are maintained at the same temperature. Then RT2 gets to a temperature of 60°C, the voltage across it is just enough to maintain drive to the heater. This condition will be maintained regardless of the ambient temperature.

Thermistor Bridge

RT1 is connected in a self-balancing bridge circuit which will deliver just enough power to the thermistor to keep it at 500 ohms. Thus, if part of the power delivered to it is from the RF generated by the oscillator and the rest is from the DC current of the bridge, then by reducing the amount of DC power, the circuit will increase the drive to the oscillator as needed to keep the total power in RT1 constant. It is only necessary to measure the amount of DC power reduction to know the amount of RF power present. In this way, a precisely known RF output level can be established.

Track & Hold and DAC

In order to know how much power is being added by the oscillator, it is necessary to measure the power delivered to the thermistor with no RF present. This is done by turning off the oscillator power (closing switch U2C), and then measuring the voltage out of the control bridge. This is known as the ambient bridge voltage. To make this measurement, the following conditions are established: U8D and U2B are switched open, and U8A & C switch closed. Then, by using the DAC, U13, a successive approximation measurement of the voltage is made. Note that the output of the DAC is connected to one input of U4, and the bridge is connected to the other. Thus, it becomes a comparator that will make it possible for the computer to tell when the output voltage of the DAC is greater than the bridge voltage, and so complete the successive approximation. Once this is done, the DAC is set for 0V output, U8A is opened, U8B is closed, U8D and U2B are closed, and the track and hold capacitor, C39, will charge up to the voltage which represents the zero RF power condition of the bridge. When the oscillator is turned on by U9C, then the sampling switch, U2B, will open and allow C39 to supply this "RF Off" condition to the measuring circuit. Any voltage from the DAC will now reduce the amount of DC power being delivered to the thermistor bridge, and the control circuit will add just enough current to the oscillator to cause its output to add back that much RF power into the bridge.

Correction Thermistor Circuit

The compensation thermistor is mounted near CR13 to sense the temperature of the 20 dB attenuator section that is used to produce the 0 dBm output. This is the only absolute power specified. All other power levels are measured by the software relative to 0 dBm.

Calibrator NVRAM Control Circuit

The calibrator serial number and the correction constant for the 0 dBm output level, as well as the date of calibration and password for rewrite access, is contained in a Non-Volatile RAM. The read and write for it is provided by the parallel peripheral interface (PPI) U18. Before allowing access to the NVRAM, the software looks for a logic one on port A, bit zero of the PPI and, if that is present, it asks the operator for the password. If the correct password is supplied, then the collected data will be written into U14. If the jumper W1 is set to supply a logic 0 to the PPI, the operator will then have write access to U14 without needing a password.

Sensor NVRAM

Each sensor has a NVRAM which is used to store all of the calibration constants, the date of calibration, place of calibration, etc. This NVRAM is also password protected, but has no hardware switch to defeat it. The read/write control for it is furnished by U41A/B/C, U41D/E/F, Q2, and Q3 which control the 5V supply in order to reduce the amount of heat in the sensor, as well as reducing the noise from the supply.

Sensor Interrupt

Each time a sensor is connected or disconnected from the 8540, a CPU interrupt is generated by causing the thermistor voltage change to set a latch which signals the CPU that it needs to check for a sensor change. The latch is driven from a "window" comparator, U39D and U40A & B. This comparator is driven from capacitors which are connected to each of the thermistor lines from the sensors. The latch is enabled or cleared by a signal from the PPI, U18.

Digital Control Circuit

The digital control circuit is the interface between the CPU and the preceding functions.

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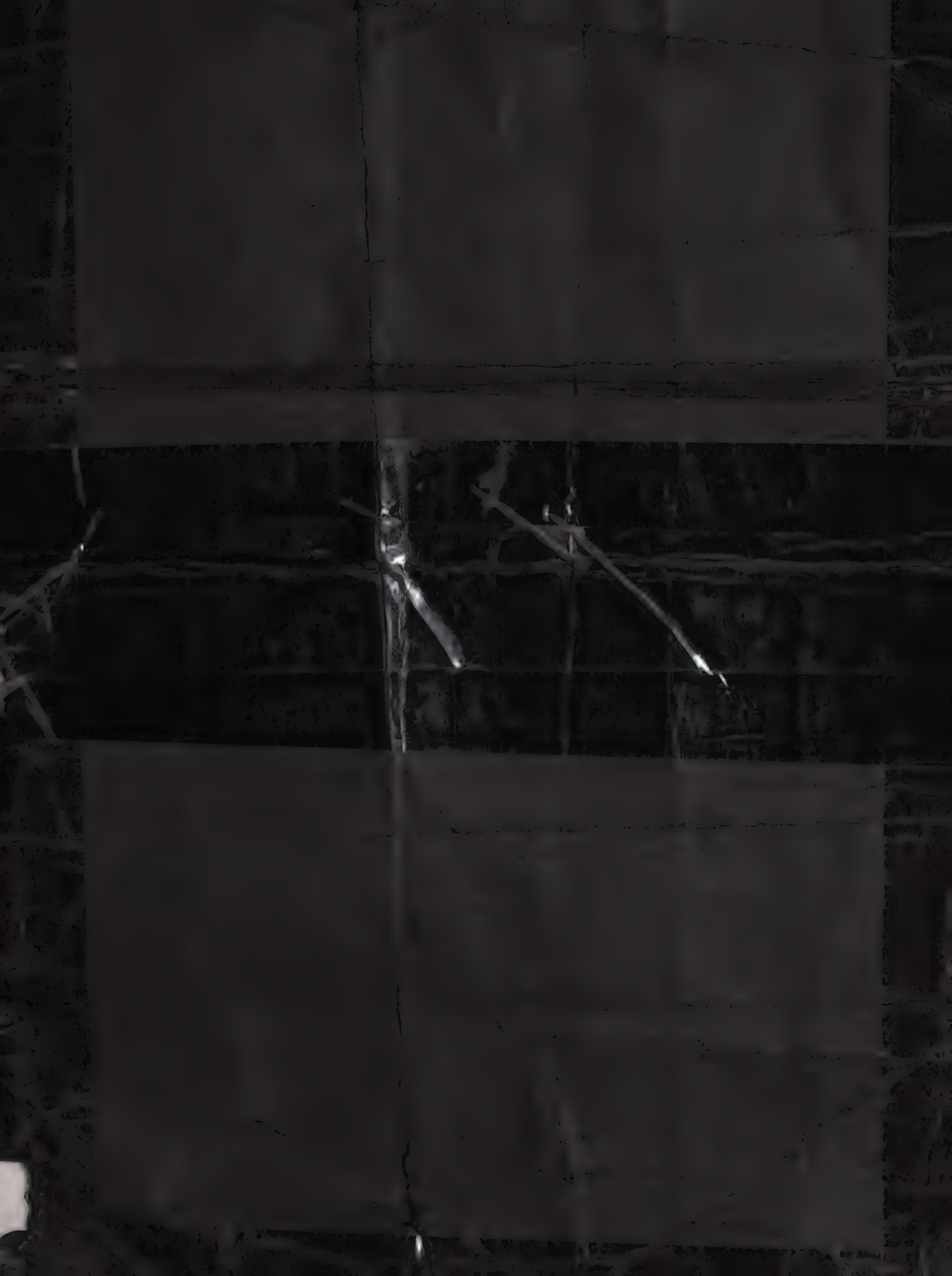

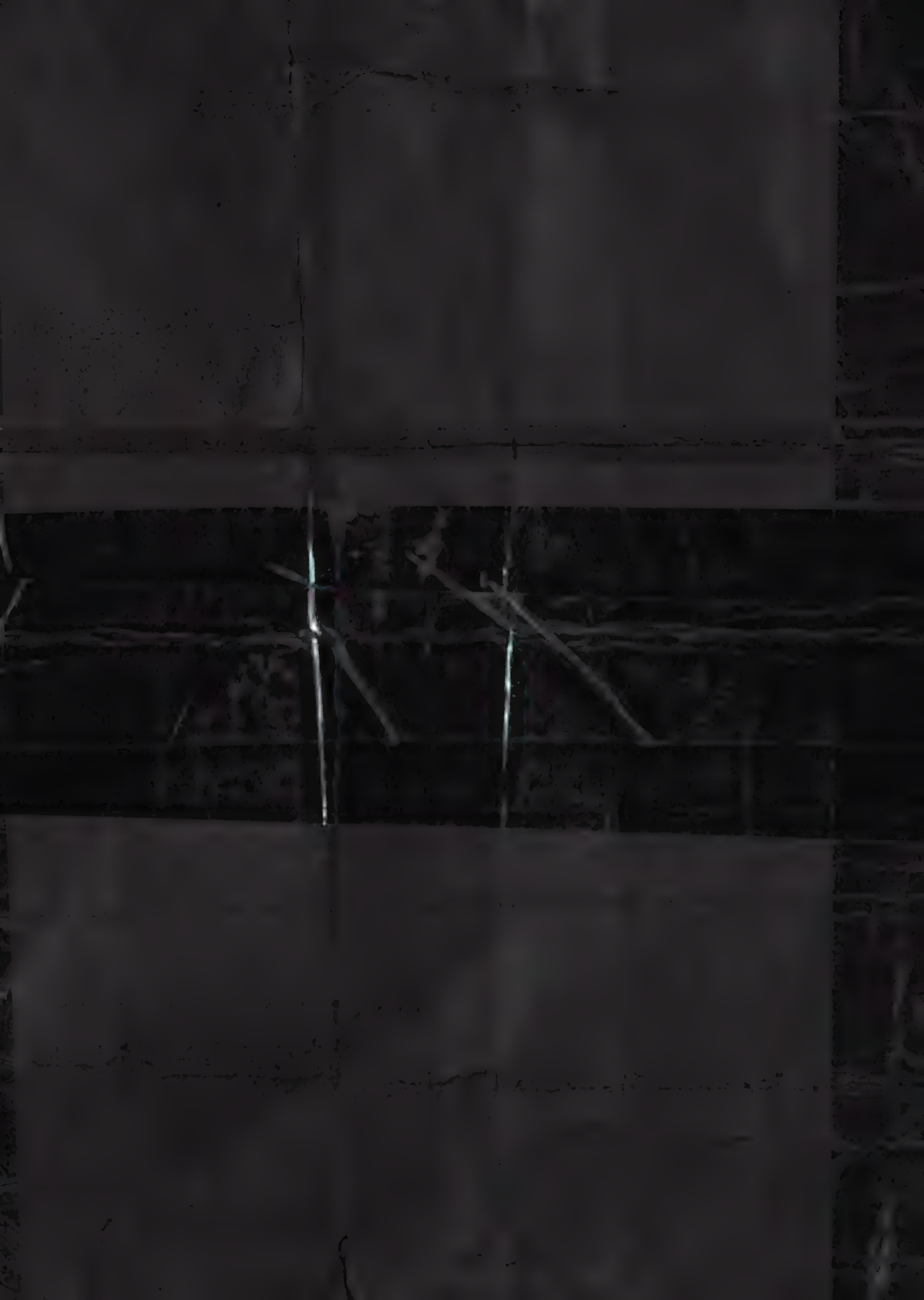

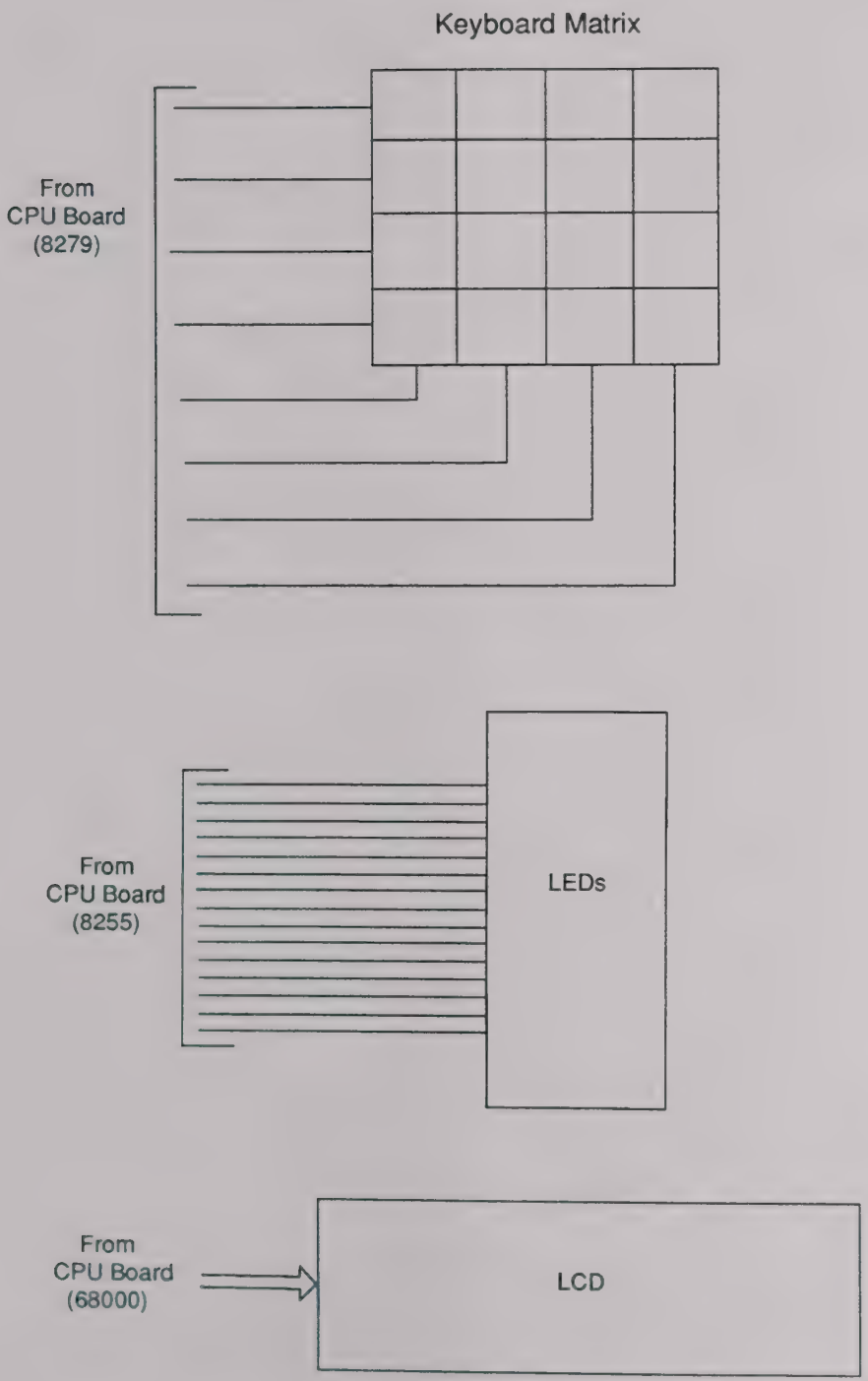

Figure 6-4. Front Panel PC Board Assembly (A3) Block Diagram

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Front Panel PC Board (A3)

(Refer to Figure 6-4 on page 6-23 and SD 21230 on page 8-25)

The Front Panel PC Board circuitry is comprised of a 4 x 4 keyboard matrix, and also contains circuitry to interface the 20 front panel LEDs to the CPU Board.

CHAPTER 7

MAINTENANCE

INTRODUCTION

This section of the manual defines maintenance practices and calibration and troubleshooting checks required for fault isolation down to PC board level.

It should be remembered that problems can occur that might be produced by equipment or components peripheral to the 8541/8542 power meter. Preliminary checks should be made to be sure that external equipment or components are not causing what appears to be a malfunction within the instrument.

PERIODIC MAINTENANCE

The maintenance and calibration procedures given in this chapter should be performed at least once each year unless the power meter is operated in an extremely dirty or chemically contaminated environment, or is subject to severe abuse (such as being dropped). In such cases, more frequent maintenance (immediate, if the unit is dropped or severely abused in some way) is required.

A. The front panel and housing of the unit can be cleaned using a cloth dampened in a mild detergent. Do not use abrasive cleaners, scouring powders, or any harsh chemicals. Wipe the soap residue off with a clean, damp cloth, then dry with a clean dry cloth.

B. Make a performance verification check in accordance with the procedures given in Chapter 5, PERFORMANCE VERIFICATION TESTS, of this manual. If the unit will pass all of the performance tests, there is no need for calibration.

CALIBRATION PROCEDURES

As an aid to executing the various calibration checks given in this section, a distinction is made in the text between the front panel keys and the software indications that they bring up on the display screen. The front panel keys are shown in **BOLD** (for example **MENU**), and the display screen indications are shown in *ITALICS* (for example *CALIBRATOR*).

Calibrator Output Power

Perform the Calibrator Output Power Reference Level check starting on page 5-3 of the PERFORMANCE VERIFICATION TESTS chapter of this manual. If the unit fails to meet the power output specification within the 0.981 mW to 1.019 mW minimum and maximum limits, then proceed with the following steps:

A. To correct the setting of the power output of the calibrator, you must know the password if it has been set, or you must defeat it by setting jumper A2W1 to position A. (This jumper is located and indicated on the Analog PC Board. You can also check Figure 8-2 on page 8-12 of the SCHEMATIC DIAGRAMS chapter for the jumpers location on the board.) If no password has been set, you can proceed with the jumper in position B. Calculate the percent error in power (as described in the Performance Verification Level check) and change the CALFAC by that amount. For example, if the power output is low by 0.5% then increase the CALFAC by that amount. In the following procedure if you make a mistake and wish to start over, press **ESCAPE** and then continue from Step 1.

1. Press **MENU**
2. Scroll to *SERVICE MENU* (using one of the up/down, left/right keys on the front panel) and press **ENTER**
3. Scroll to *CALIBRATOR* and press **ENTER**
4. Select *EEPROM* and press **ENTER**
5. Press **ENTER** to get past *SNumb* (unit serial number)
6. Enter CALFAC change using the number obtained at the beginning of this test. Press **ENTER**
7. Correct the *DATE* and press **ENTER**

8. Correct the *TIME* and press **ENTER**

9. Select *WRITE* and press **ENTER**

10. Enter the correct password if needed. If it is not needed, you can either set one or clear it.

11. Press **ENTER**

B. The sensor(s) can now be calibrated by connecting to the calibrator output and pressing **ZERO/CAL**. If the calibration does not complete satisfactorily, refer to the calibrator voltage and frequency checks starting on page 7-4.

C. The Linearity test can now be performed as detailed on page 5-5 of Chapter 5. This is a complete procedure, and must be performed in the exact order given to produce accurate results. If this test fails, try it again with a defferent sensor. If it still fails, refer to the calibrator voltage and frequency checks given starting on page 7-4.

The following tests require that the power meter's housing be removed. To remove the cover, remove the three Binder head screws on the back panel and slip the cover off. This can best be done by carefully resting the unit on the front panel using a cushion or pad to prevent scratching.

The same test equipment that was used for the Performance Verification Tests can be used for these tests.

Refer to the Analog PC Board description on page 6-13 for further help in defining the problem. If the fault cannot be located to the component level, the PC board can be removed and replaced with a different one with no further calibration required except to set the calibrator output power to 0 dBm

Battery

The power meter contains a 3.6V lithium battery to maintain the data pertaining to all of the instrument's test setups and calibration data when the unit is turned off. This battery should last in excess of five years. To check the battery, connect a voltmeter between A1TP13 (ground) and A1TP16 (+) indicated on the CPU PC Board. (See Figure 8-1 on page 8-6 of the SCHEMATIC DIAGRAMS chapter for the location of these test points, if necessary.) If the voltage is less than 3.1V, the battery should be replaced.

This can be done without losing the data stored in the RAMs if the old battery is removed and the new battery installed in less than 10 seconds with mains power off, or if power is left on while changing the batteries.

Power Supply Voltage Checks

There are 6 power supplies in the power meter. [The rectifiers, filters, and regulators for the ±15 volt and the +5 volt supplies are on the CPU PC Board (A1). The ±12 volt regulators and the -10 volt reference supply are on the Analog PC Board (A2). In case there is a regulated voltage failure, check the corresponding unregulated supply referencing SD 21096 Sheet 3 on page 8-11 of the SCHEMATIC DIAGRAMS chapter. The unregulated voltage must be at least 2 volts more than the required regulated output.] To measure the supplies, turn the unit on and let it stabilize for a minute or so. Then proceed as follows:

1. Connect the DVM from A2TP3 (ground) to A2TP2 (+). (A2 is the Analog PC Board.) Measure +14.4V to +15.6V.

2. Connect the high side of the DVM to A2TP4. Measure -14.4V to -15.6V.

3. Connect the high side of the DVM to A2TP5. Measure +4.75V to +5.25V.

4. Connect the high side of the DVM to A2U33, pin 11. Measure +11.4V to +12.6V.

5. Connect the high side of the DVM to A2U33, pin 5. Measure -11.4V to -12.6V.

6. Connect the high side of the DVM to A2U16, pin 1. Measure -9.1V to -10.9V.

Calibrator Voltages

To measure the calibrator voltages, first make sure that neither side of the DVM is grounded. The following measurements should find most of the problems that can arise in the calibrator circuitry.

1. Connect the DVM across the large resistor, A2R174. Measure 0.4 to 0.9 volts depending on the room temperature and how long the unit has been operating. This voltage is proportional to the current in the thermistor heater transistor which maintains the calibrator thermistor in a 60°C environment. The voltage measured in the next step is dependent on this being correct.

NOTE: The exact ambient temperature and on-time of the instrument mentioned in Step 1 are not specific factors, but do have some effect on the reading taken across A2R174. If there is a problem in the circuit, the measured voltage will usually be some amount way outside of the 0.4 to 0.9 volt spec (such as 0 volts or +4 or 5 volts).

2. Connect the low side of the DVM to A2TP3 and the high side to A2TP1. Measure +7 to +8.5 volts. This is the voltage applied to the thermistor bridge that is used to measure the calibrator power. This voltage will vary as the calibrator provides different amounts of RF power. This measurement assumes that the calibrator is OFF. To verify that the calibrator is off, press **MENU**, scroll to *REF POWER ON/OFF*, press **ENTER**, select *OFF*, and press **ENTER** again.

3. Turn the calibrator ON. Press **MENU**, scroll to *REF POWER ON/OFF*, press **ENTER**, select *ON*, and press **ENTER**. Now connect the high side of the DVM to A2U3, pin 7. Measure +3 to +10 volts which should change less than 2 mV per minute. Turn the calibrator off. It the voltage is incorrect or drifts excessively, troubleshoot the sample and hold circuit surrounding A2U3A.

Calibrator Frequency Check

To measure the frequency of the calibrator:

1. Connect a 50 MHz counter to the calibrator output connector.

2. Turn ON the calibrator according to the procedure given in Step 3, above.

3. Measure 49 to 51 MHz.

4. Turn OFF the calibrator.

GPIB Test Functions

If the unit will not calibrate its sensors, there are some test functions available through the GPIB. Using these functions, it is possible to check out the operation of the different parts of the calibrator system.

1. Connect a controller to the GPIB interface connector on the rear panel of the unit, and set the address as required.

a. Press **MENU**. Scroll to *SETUP MENU* and press **ENTER**

b. Scroll to *GPIB SETUP* and press **ENTER**

c. Select the *MODE* and *ADDRESS* as needed and press **ENTER** (*MODE* is either 8541 or 8542. Default address is 13)

2. If the calibrator output power as measured in the Performance Verification Test is within tolerance but the unit will still not complete a sensor calibration, perform the following test to determine if the calibrator is operating correctly:

   a. Send "TEST CALIB SOURCE 10" from the controller, followed by "TEST CALIB ATTEN 0".

   The calibrator output should be +20 dBm ±0.8 dB.

   b. Send "TEST CALIB ATTEN 10".

   This will insert the 10 dB attenuator into the calibrator output. The power should measure a decrease of 10 dB ±1 dB.

   c. Repeat Step b, substituting "20", "30", and "40" successively in the command.

   The power should be attenuated by the attenuation level specified in the command ±1 dB. This will verify the health of all of the attenuators.

3. The next step is to verify the oscillator power control circuits. This is done by setting the power to higher and lower levels and measuring the results.

   a. Send the command "TEST CALIB ATTEN 0", followed by "TEST CALIB SOURCE X" where X is -3 to +13. The resulting power output should range between -13 dB from the first reading taken in Step 2.a to at least +21 dBm.

This checks the calibrator control circuits completely. If the unit still will not calibrate a sensor the problem is in the measurement circuits, not the calibrator. Proceed to the next heading.

8542 B Channel Troubleshooting

If the instrument being tested is a Model 8542 and only one channel will calibrate, troubleshoot the circuits associated with the channel that fails. The separate channels are shown on Sheet 1 (Ch A) and Sheet 2 (Ch B) of SD 21182 on pages 8-13 and 8-15 of the next chapter. For example, if the unit will calibrate channel A but not channel B, proceed as follows:

1. If the unit fails to display the "B UNCALIBRATED" message, or fails to display any B channel data when the sensor is connected the problem lies in the temperature sensing thermistor circuit which connects to U39, pin 3.

    a. Measure the voltage at U39, pin 1. It should be about 2 or 3 volts. If it is above 7 or below 0.5 volts, the thermistor circuit is faulty.

2. Try reversing the two sensors to determine if one of them is bad.

ADDENDUM

LITHIUM BATTERY REPLACEMENT (Recommended every three years)

CAUTION: The following information describes a replacement procedure for the lithium battery in the 8540 Series Power Meters. Since this procedure requires removing the cover from the instrument and then restoring power ***before*** removing the battery, this procedure should only be performed by qualified personnel.

Lithium batteries can supply substantial current and, depending on factors such as the state of charge, can overheat when shorted.

Information on testing the battery is given in the last paragraph of these Replacement instructions. The following replacement procedure is intended for users knowledgeable in the use and care of equipment using non-rechargeable lithium batteries.

The 8540 Series use a lithium battery to maintain power to the built-in clock chip and the static RAM used to store instrument data such as sensor linearity tables, power down status, and stored setups.

Battery life varies depending on the usage of the 8540 instrument but will be at least three years assuming normal daily use of the instrument. To save possible inconvenience that can be caused by the unintentional loss of data in the volatile memory of the 8540, it is recommended that the lithium battery be replaced every three years.

If the instrument is to be placed in long term (2 years or more) storage, the battery should be removed.

Recommended Replacement Battery: Tadiran Type TL-5242
Giga-tronics Part Number 21212

8540 LITHIUM BATTERY REPLACEMENT PROCEDURE:

1. Turn OFF the 8540.
2. Remove the cover.
3. Turn ON the 8540 (to maintain memory power while replacing the battery).
4. Note the orientation of the battery which is located on the left side of the top (CPU) PC board half way back in the unit. The battery is held in place with a plastic clamp and a "hook and loop" fastener. Cut the plastic clamp and peel the battery free of the PC board.

5. Disconnect the battery wires. The connector is polarized so it can only be inserted one way, with the red wire toward the rear of the instrument.

6. Install the new battery, replace the plastic clamp, and connect the wires.

7. Turn OFF the 8540 and measure the battery voltage between TP13 (com) and TP17 (bat). It must be at least 3.5V.

8. Replace the cover and secure.

9. If desired, a label can be attached indicating when the next battery replacement is due.

This completes the replacement procedure.

To test for satisfactory operation of the new battery, turn ON the 8540, calibrate a sensor, turn the 8540 OFF, wait ten seconds, and turn the 8540 instrument back ON. The sensor calibration should still be valid as indicated by a display of the power level.

CHAPTER 8

SCHEMATIC DIAGRAMS (SD) AND ASSEMBLY DRAWINGS

(PC Board Component Part Locations)

Reference Designation		Drawing Number	Page Number
	8540 Series Power Meter SD (2 Sheets)	21246	8-3
A1	CPU PC Board Assembly Dwg. (Figure 8-1)	21095	8-6
	CPU PC Board SD (3 Sheets)	21096	8-7
A2	Analog PC Board Assembly Dwg. (Figure 8-2)	21181	8-12
	Analog PC Board SD (6 Sheets)	21182	8-13
A3	Front Panel PC Board Assembly Dwg. (Figure 8-3)	21229	8-24
	Front Panel PC Board SD	21230	8-25
A4	LCD Display Assembly	21246	8-3

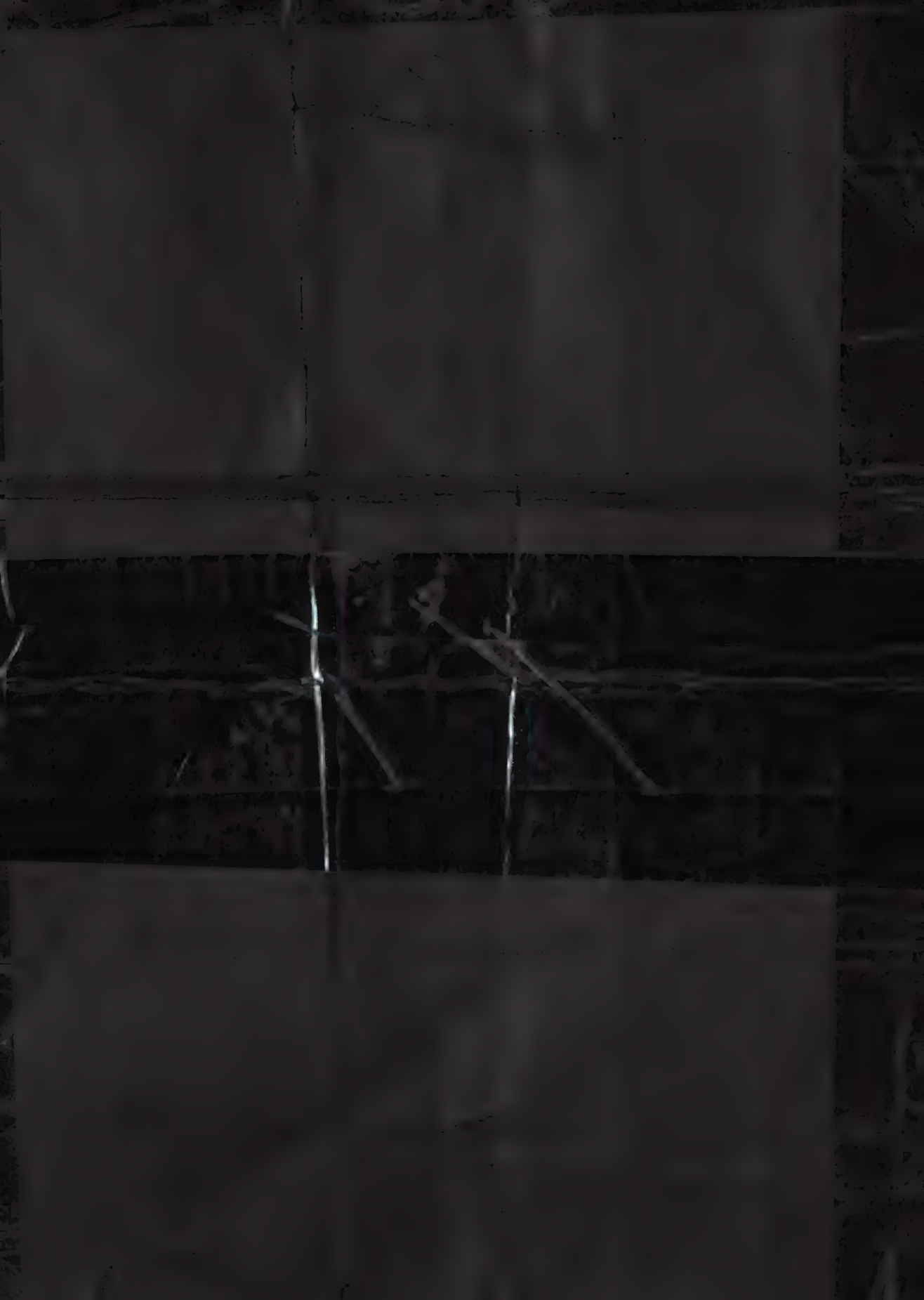
NOTICE

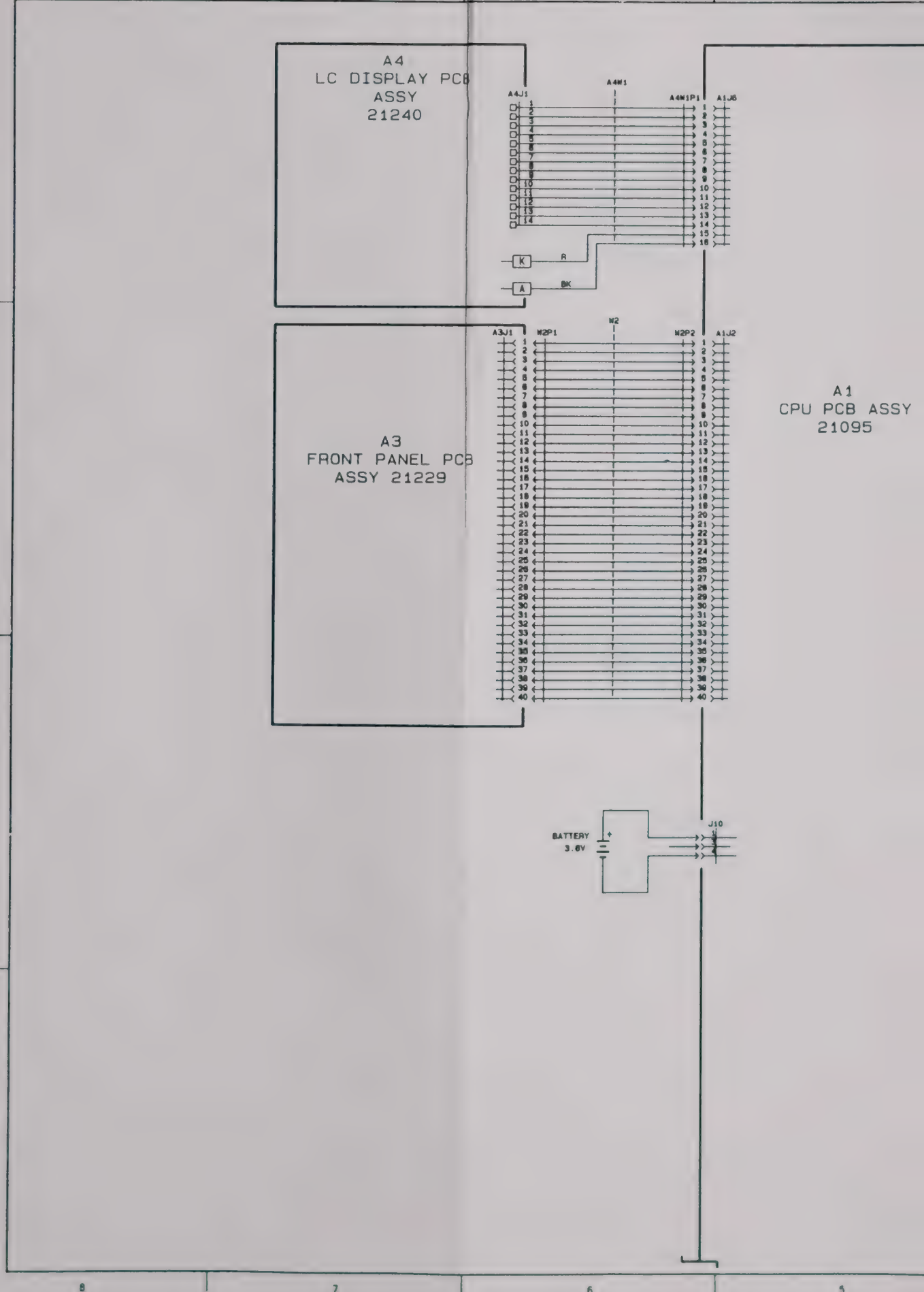
All of the Schematic Diagrams (SD) shown in this chapter are valid for both the Model 8541 and Model 8542 Power Meters. Since the 8541 has only one channel, certain portions of the circuitry shown in the SDs will not pertain to the 8541.

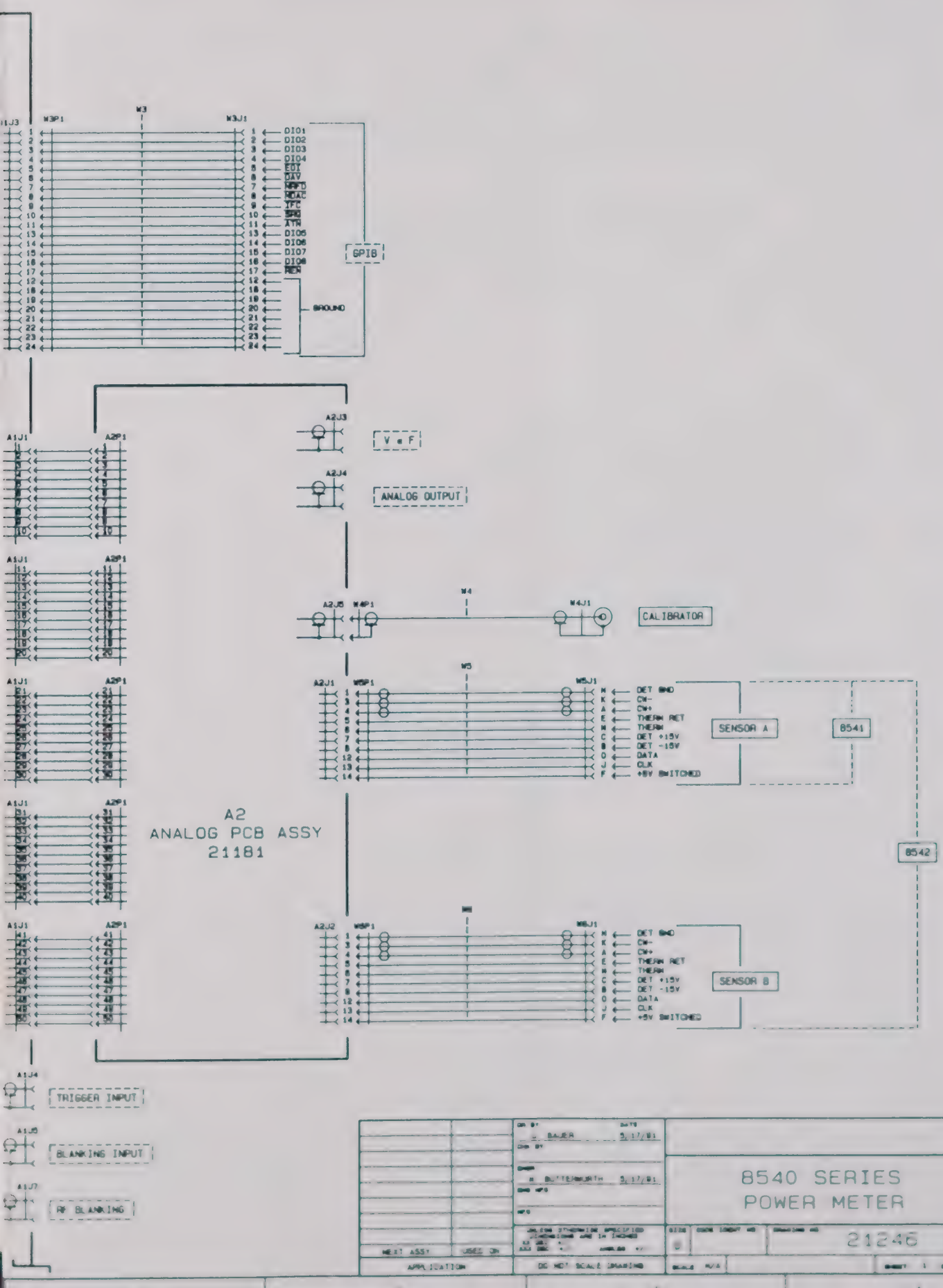
To assist those users with 8541 instruments, dotted lines have been placed around any circuit areas shown in the SDs that are either specific to the 8541 or do not pertain to the 8541. Inside these dotted lines will appear either "8541" or "NOT USED IN 8541" printed in a box. These dotted line areas appear on the following SDs:

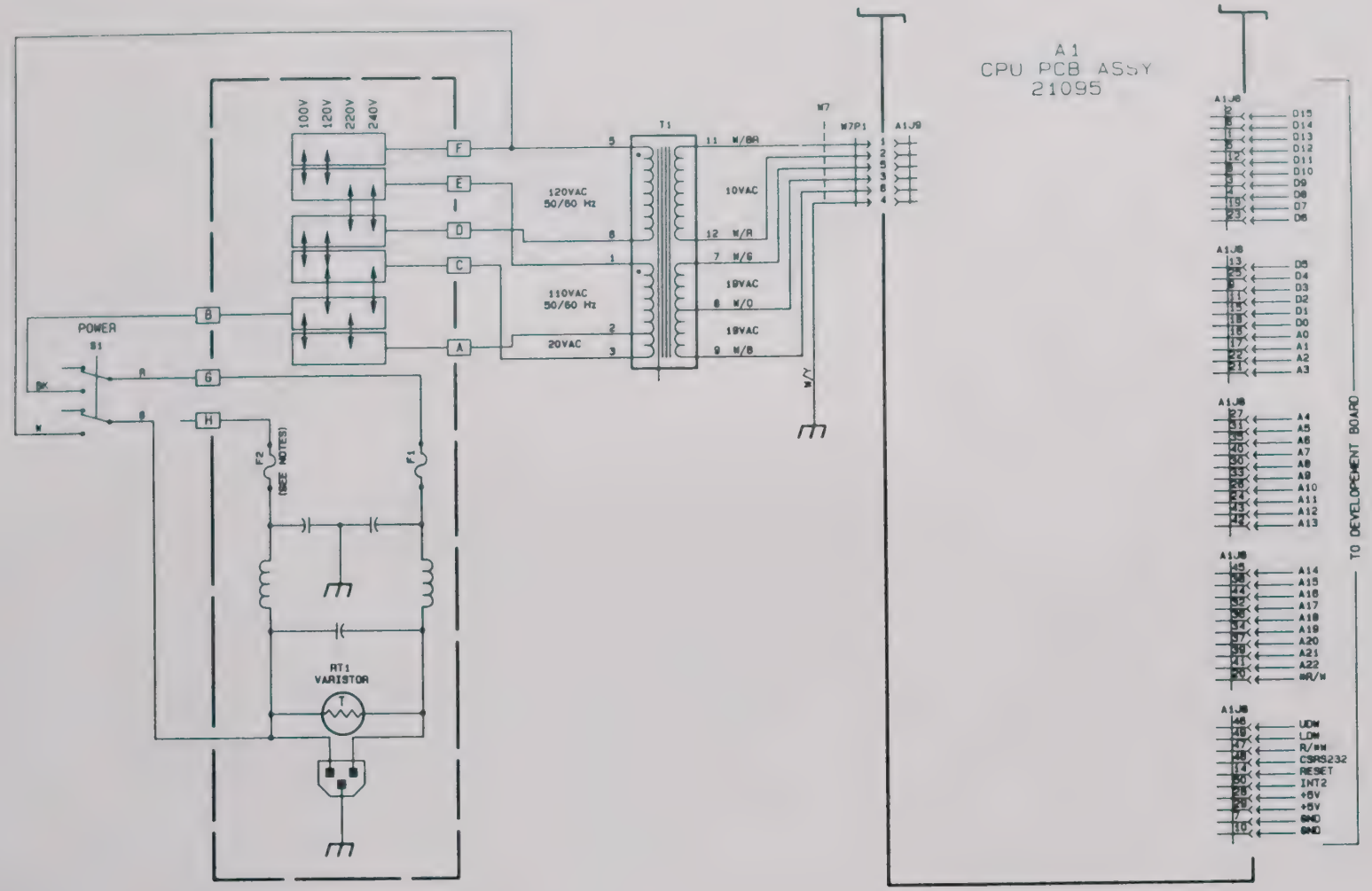
SD	Page	Location on the SD
21246 Sheet 1	8-3	Right side of the sheet
21182 Sheet 2 [1]	8-15	Entire upper portion
21182 Sheet 3	8-17	Lower center of sheet (U17 and peripheral components)

[1] On SD 21182 Sheet 2, U32C&D (shown in the lower, right section of the SD) are part of a quad amp. The 8542 instrument uses all 4 quad sections of U32, whereas the 8541 unit uses only U32 A&B. U32 is physically placed on the Analog PC Board in the 8541, but sections C&D are not used.




A4
LC DISPLAY PCB
ASSY
21240
A4J1
A4W1
A4W1P1
A1J6
K
R
A
BK
A3
FRONT PANEL PCB
ASSY 21229
A3J1
W2
W2P1
W2P2
A1J2
A1
CPU PCB ASSY
21095
BATTERY
3.6V
J10


W3
W3P1
W3J1
GPIB
GROUND
A2J3
V a F
A2J4
ANALOG OUTPUT
A2J5
W4P1
W4
W4J1
CALIBRATOR
W5
W5P1
W5J1
SENSOR A
8541
8542
A2J2
W6
W6P1
W6J1
SENSOR B
A2
ANALOG PCB ASSY
21181
A1J4
TRIGGER INPUT
A1J5
BLANKING INPUT
A1J7
RF BLANKING
8540 SERIES
POWER METER
21246
4



NOTES (UNLESS OTHERWISE SPECIFIED):
1. F2 IS PROVIDED FOR DUAL EUROPEAN FUSING

		DR BY J. BAUER DATE 5/17/91	8540 SERIES POWER METER
		CHK BY	
		ENGR M. BUTTERWORTH 5/17/91	
		ENG APR	
		APR	
NEXT ASSY	USED ON	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES .XX DEC +/- .XXX DEC +/- ANGLES +/-	SIZE D · CAGE IDENT NO · DRAWING NO 21246 · REV 4
APPLICATION		DO NOT SCALE DRAWING	SCALE N/A · SHEET 2 OF 2

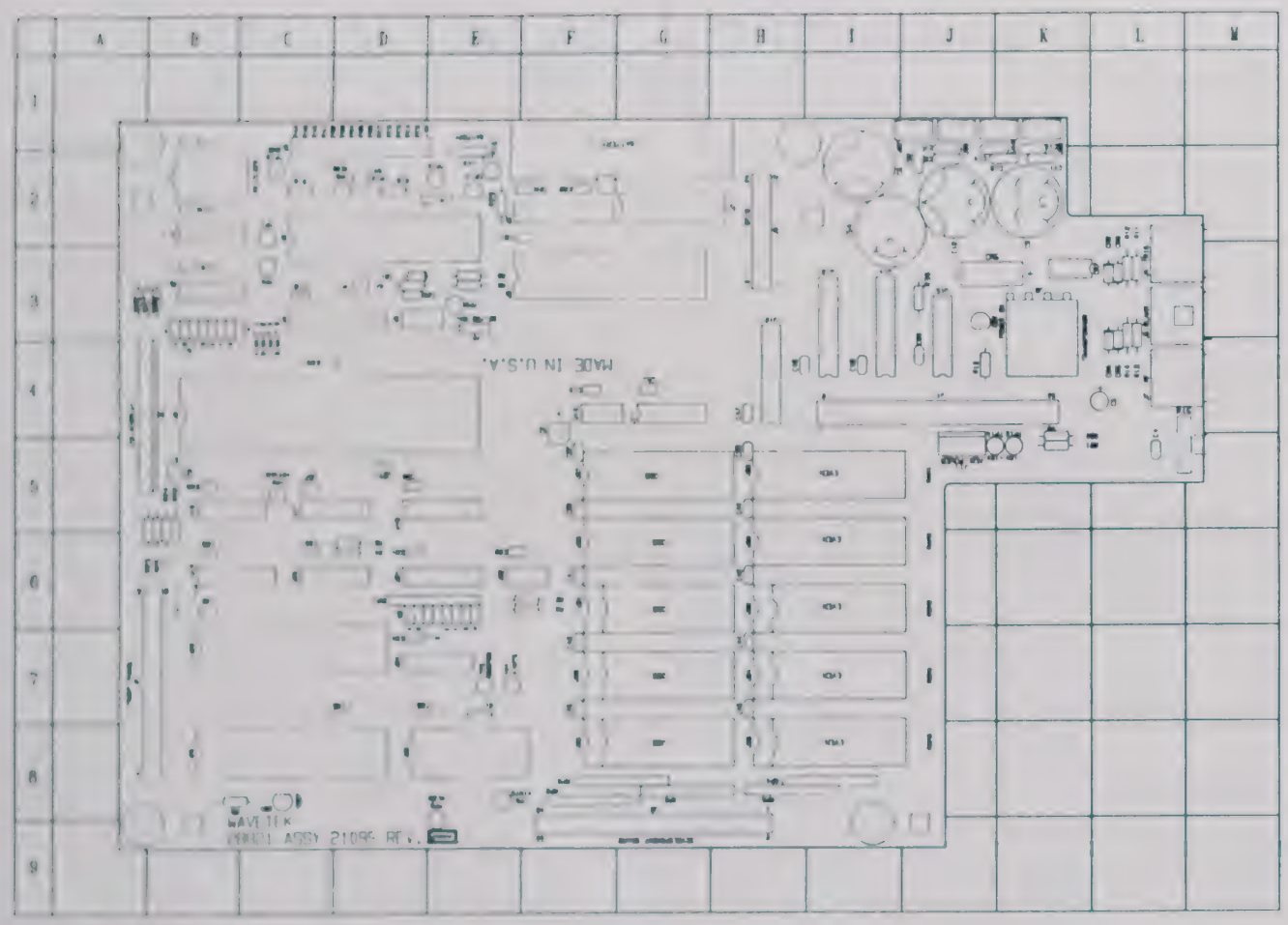
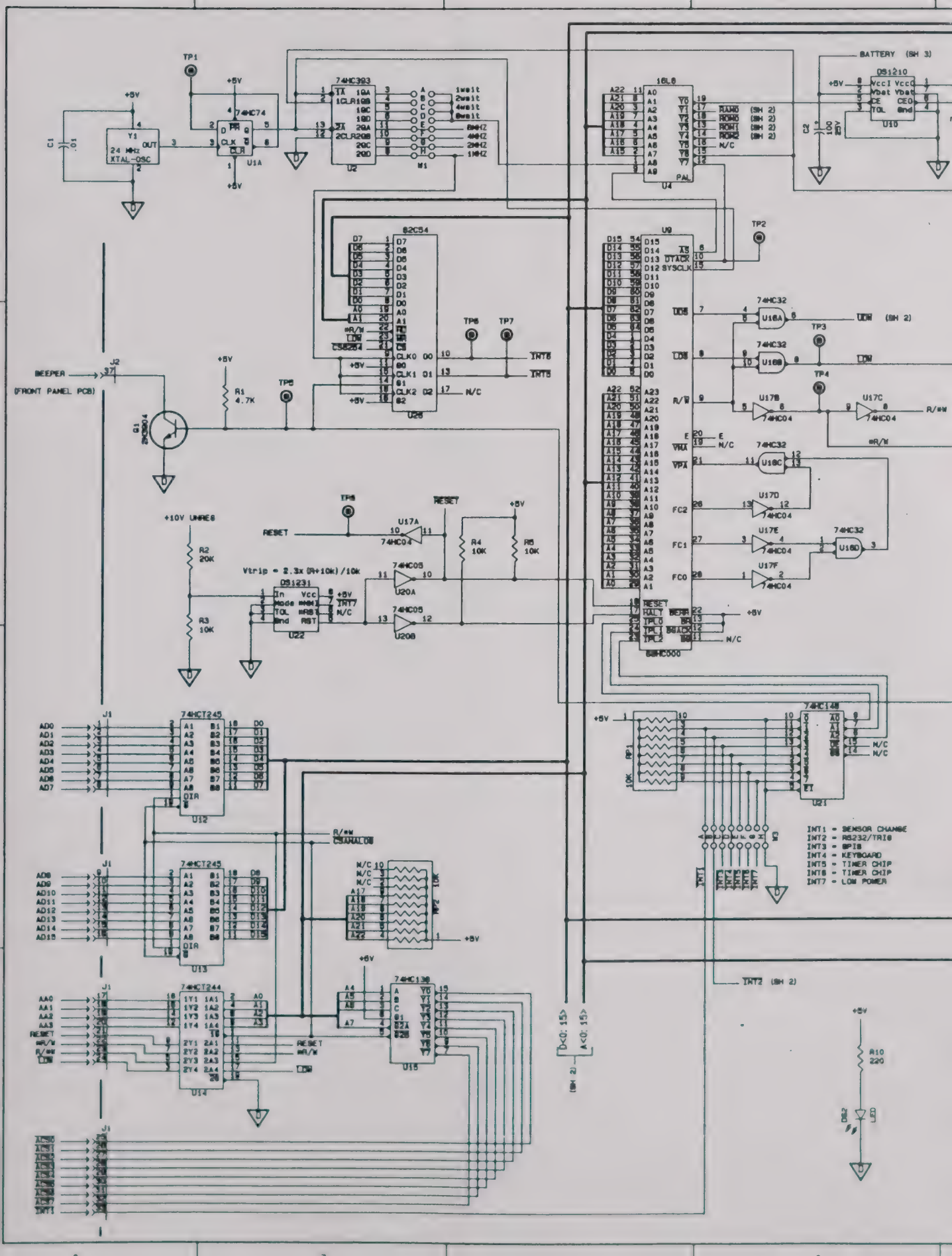
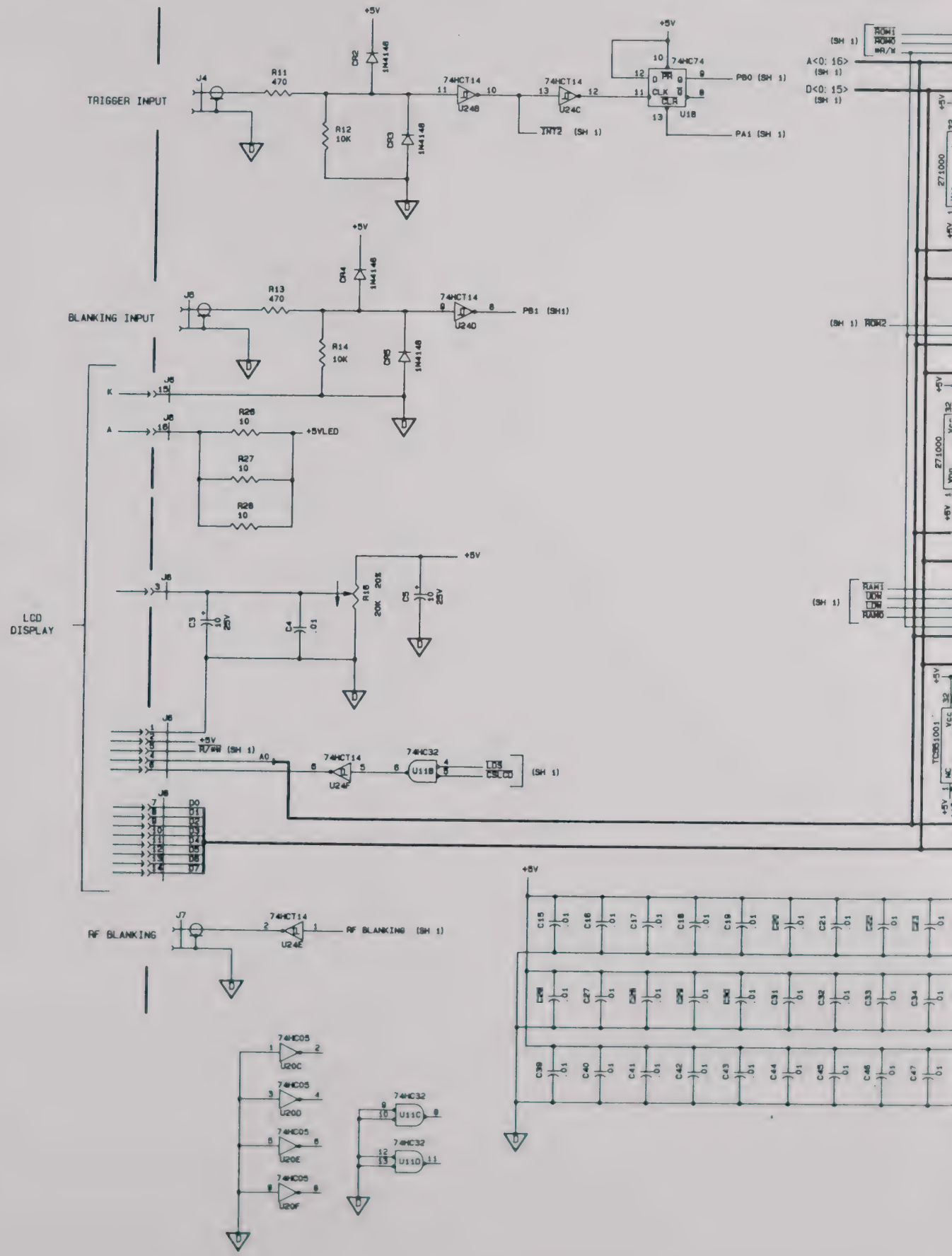


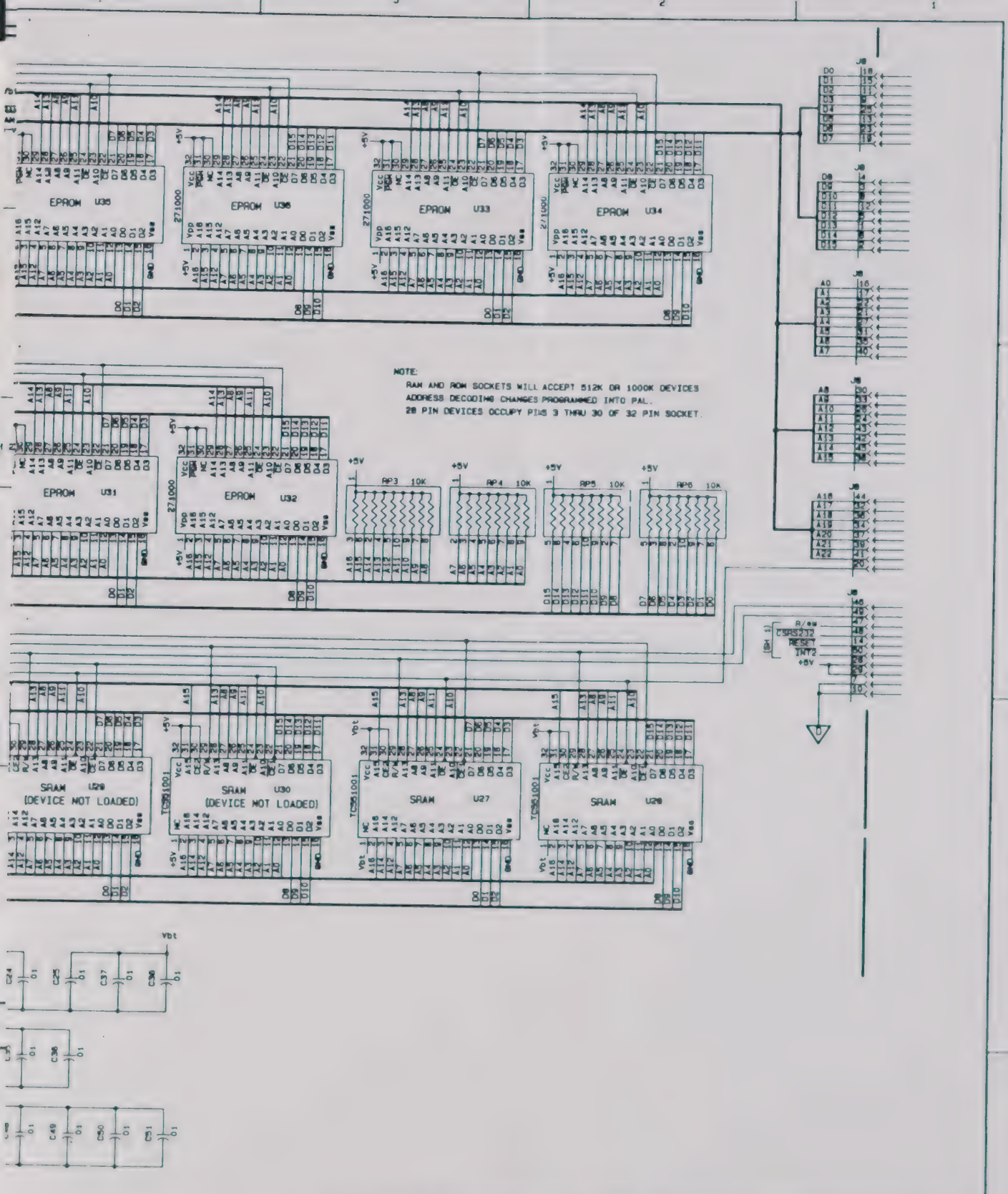
Figure 8-1. CPU PC Board Assembly (A1) #21095

COMPONENT LOCATION TABLE																							
CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC
C1	B1	C23	C4	C45	F7	DS1	C8	J10	E2			RP1	D6	TP1	D1	U8	E8	U15	F8	U21	B7	U27	B1
C2	F4	C24	D5	C46	H7	DS2	J4	J11	F5				E6	TP13	C1		F8		D8		D6		
C3	B5	C25	D3	C47	H4					R16	M4	RP2	F8	TP14	K4		K8	U16	F6	U22	B7	U28	B6
C4	L5	C26	B5	C48	H4						M5	RP3	F8	TP15	K4	U9	K4		G8		D5		E5
C5	L4	C27	C5	C49	I4	T1	I4	Q1	B6				G8	TP16	E1		L4	U20	F6	U23	B7	U29	B7
C6	I2	C28	D5	C50	J4		J4			R18	D2	RP4	H8	TP17	E1		M4		F6		D7		D7
C7	J2	C29	B6	C51	G4		K4	R1	E7	R19	C2		I8				P4	U24	B7	U24	E7		
C8	J2	C30	C6	C52	J2	T2	A6	R2	F6	R20	K4	RP5	H8			U10	F4		D7		D7		
C9	K2	C31	D6				A7	R3	F6	R21	K4		I8			U11	G4		D7	U25	K7		
C10	K2	C32	E6	C54	I2		A8	R4	D6	R22	B5	RP6	G8	U1	B2	U12	K4	U26	B7		E7	Y1	B2
C11	K2	C33	B6			T3	K2	R5	D6		B6			U2	B3	U13	I3		E7	U28	F8	Y2	B3
C12	J2	C34	D7	CR1	D3		K3	R6	D8	R23	A5			U3	C2		I4	U27	B8		D8		
C13	K2	C35	D7	CR2	L3	J4	L3	R7	D3		A6	TP1	C2		D2	U14	I3		D8	U28	K8		
C14	J2	C36	D7	CR3	L3	J5	L3	R8	E3	R24	B5	TP2	C5		E2		I4		D8		I4		
C15	B2	C37	F5	CR4	L3	J6	B4	R9	E3		B6	TP3	E8	U4	C3	U15	J3	U28	D8	U27	I1		
C16	B3	C38	H5		L4		B5	R10	J4	R25	B5	TP4	C3		C3		J4		E8		J1		
C17	E2	C39	F5	CR5	L3	J7	L4	R11	L3		B6	TP5	E7	U5	D3	U16	B5	U27	B5	U28	J1		
C18	C3	C40	H5		L4	J8	F9	R12	L3	R26	A3	TP6	E8		E3	U17	C5		E5	U29	K1		
C19	F4	C41	F6	CR6	J3		G9	R13	L3	R27	B3	TP7	E7	U6	D2		D5	U28	K5	U27	J1		
C20	F2	C42	H6		K3		H9		L4	R28	B3	TP8	D2		E2	U18	D5		D1		K1		
C21	F2	C43	F7	CR7	K3	T9	K3	R14	L3	R29	F2	TP9	E3	U7	G2		E5	U29	K5				
C22	F2	C44	H8				K4		L4	R30	J3	TP10	E2		K2	U18	B6		D8				
												TP11	D3										


TP1
+5V
74HC393
74HC74
U1A
U2
1wait
2wait
4wait
8wait
8MHZ
4MHZ
2MHZ
1MHZ
Y1
24 MHz
XTAL-OSC
C1
.01
16L8
U4
PAL
BATTERY (SH 3)
DS1210
U10
C2
.1
82C54
U26
TP6
TP7
INT6
INT5
N/C
BEEPER
(FRONT PANEL PCB)
J2
Q1
2N3904
R1
4.7K
TP5
+10V UNREG
R2
20K
R3
10K
RESET
U17A
74HC04
R4
10K
R5
10K
Vtrip = 2.3x (R+10K)/10K
DS1231
U22
74HC05
U20A
U20B
INT7
U9
TP2
TP3
TP4
74HC32
U16A
U16B
U16C
U16D
U16E
U17B
U17C
U17D
U17E
U17F
UDW (SH 2)
LDW
R/W
#R/W
E
VMA
VPA
FC2
FC1
FC0
HALT
BERR
IPL0
IPL1
IPL2
BGACK
68HC000
J1
74HCT245
U12
U13
AD0
AD1
AD2
AD3
AD4
AD5
AD6
AD7
AD8
AD9
AD10
AD11
AD12
AD13
AD14
AD15
R/#W
CHANNEL08
74HCT244
U14
AA0
AA1
AA2
AA3
RESET
#R/W
LDW
74HC138
U15
A4
A5
A6
A7
D<0:15>
A<0:15>
(SH 2)
RP1
10K
74HC148
U21
INT1 = SENSOR CHANGE
INT2 = RS232/TRI0
INT3 = SPI0
INT4 = KEYBOARD
INT5 = TIMER CHIP
INT6 = TIMER CHIP
INT7 = LOW POWER
INT2 (SH 2)
A10
220
LED2
LED

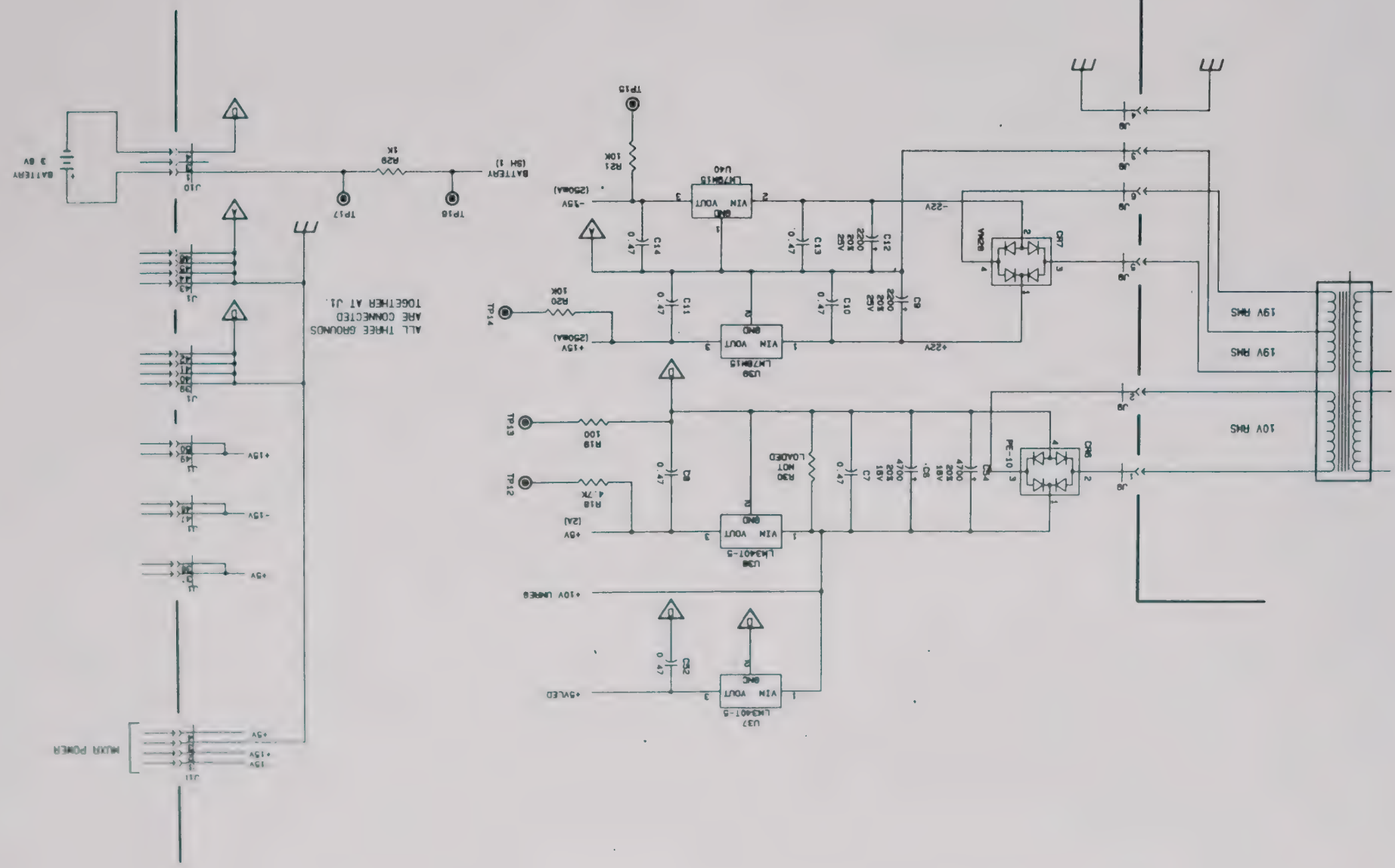
74HC138
U18
TMS9914
U8
75160
U6
75162
U7
74HC32
U11A
CONTROLLER
GPIB XCVR
82C55
U25
8279
U23
74HC138
U19
74HCT14
U24A
TO FRONT PANEL PCB
R22 100K
R23 100K
R24 100K
R25 100K
R6 220
D81
LED
R8 4.7K
R9 4.7K
R7 4.7K
TP9
TP10
TP11
DS1202
Real Time Clock
Y2
32.768KHz
CR1
1N914
U5
+5V
GROUND
SPARES
RESET
CSLED
CS8279
CS82C55
CS8914
CS74HC138
CS8254
CS74HC688
CSLCD
CS82770
CSRS232
WAVETEK MICROWAVE INC
CPU PC BOARD
21096
REV 11
D
BAUER
2/27/91
BUTTERWORTH
DO NOT SCALE DRAWING
APPLICATION
NEXT ASSY
USED ON


TRIGGER INPUT
J4
R11
470
R12
10K
DR2
1N4148
DR3
1N4148
74HCT14
U24B
74HCT14
U24C
74HC74
U18
INT2 (SH 1)
PB0 (SH 1)
PA1 (SH 1)
+5V
BLANKING INPUT
J5
R13
470
R14
10K
DR4
1N4148
DR5
1N4148
74HCT14
U24D
PB1 (SH1)
J6
K
A
R26
10
R27
10
R28
10
+5VLED
LCD
DISPLAY
R15
20K 20%
C3
10
25V
C4
.01
C5
10
25V
RD#WR (SH 1)
A0
74HCT14
U24F
74HC32
U11B
LDS
CSLCD
(SH 1)
J7
D0
D1
D2
D3
D4
D5
D6
D7
RF BLANKING
J7
74HCT14
U24E
RF BLANKING (SH 1)
74HC05
U20C
74HC05
U20D
74HC05
U20E
74HC05
U20F
74HC32
U11C
74HC32
U11D
A<0:16>
(SH 1)
D<0:15>
(SH 1)
ROW1
ROW2
RD/WR
(SH 1) ROW2
RAM1
DCW
LCW
ROM0
(SH 1)
271000
271000
TC551001
C15
C16
C17
C18
C19
C21
C22
C23
C24
C25
C26
C27
C28
C29
C30
C31
C32
C33
C34
C35
C36
C37
C38
C39
C40
C41
C42
C43
C44
C45
C46
C47
C48
.01



	DR BY J. BAUER	DATE 2/27/91	WAVETEK MICROWAVE INC
	CHK BY		CPU PC BOARD
NEXT ASSY	USED ON	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	SIZE C — DRAWING NO 21096 — REV 11
APPLICATION		DO NOT SCALE DRAWING	SCALE 0 — SHEET 2 OF 3

WAVETEK MICROWAVE, INC. SANTEE, CALIFORNIA	DO NOT SCALE DRAWING	APPLICATION	
		USED ON	NEXT ASSY
CPU PC BOARD			
SIZE D / DRAWING NO 21096 / REV 11	DRAWN J. BAUER 2/25/91 / CHKD M. BUTTERWORTH / ENGR / ENGR MFG / ENGR QUAL / DWG APPD		
SCALE 0 / SHEET 3 OF 3			



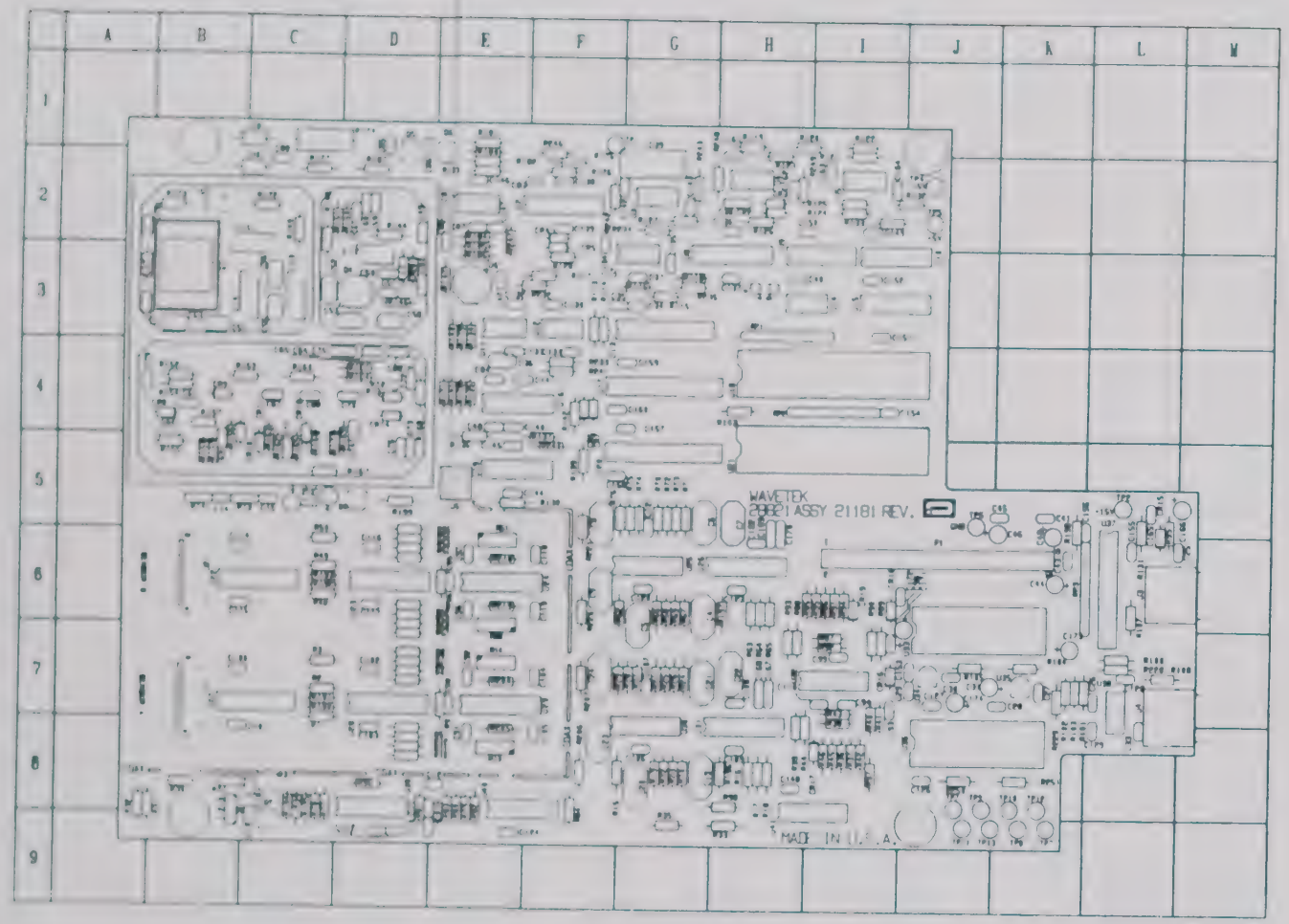
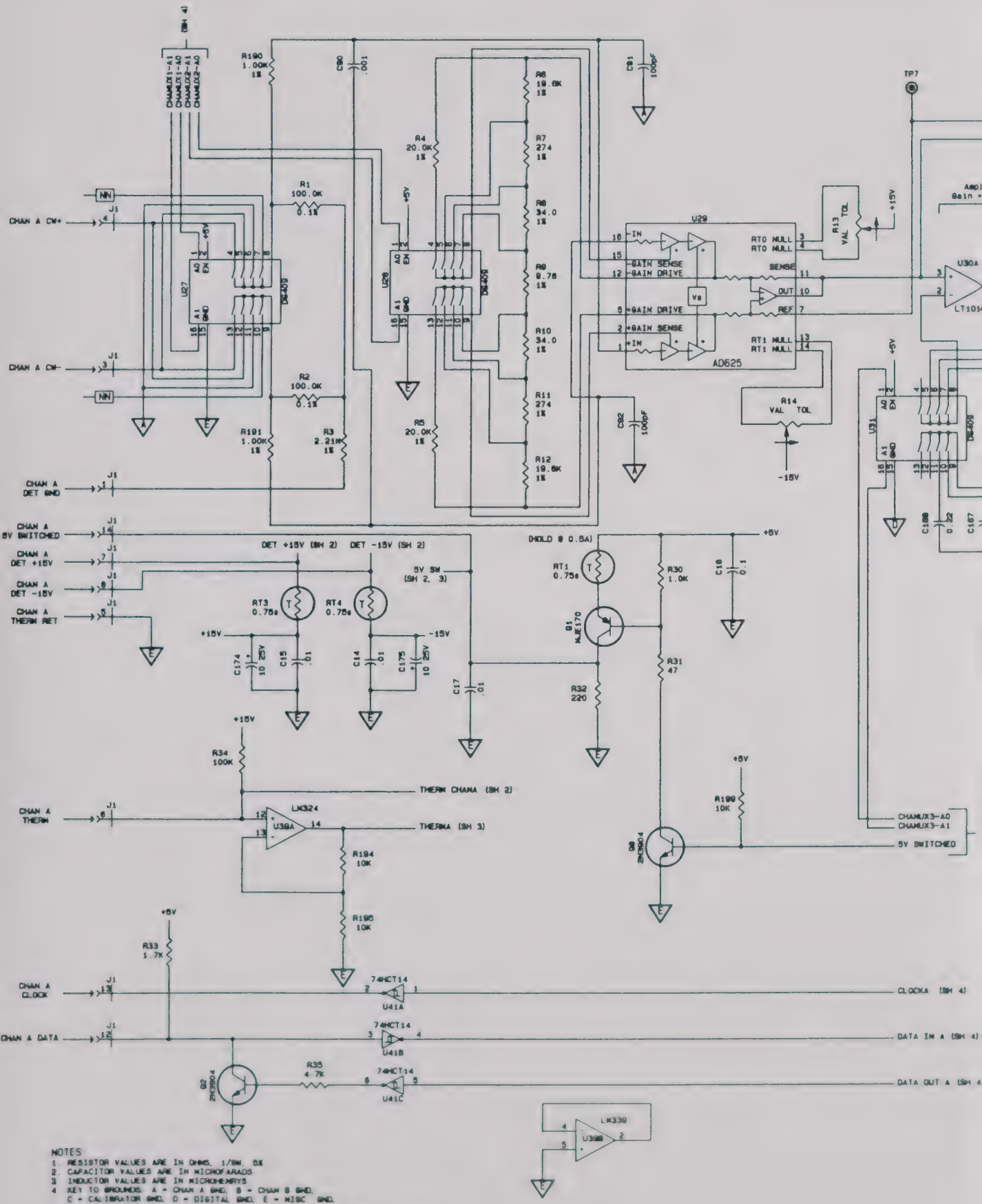
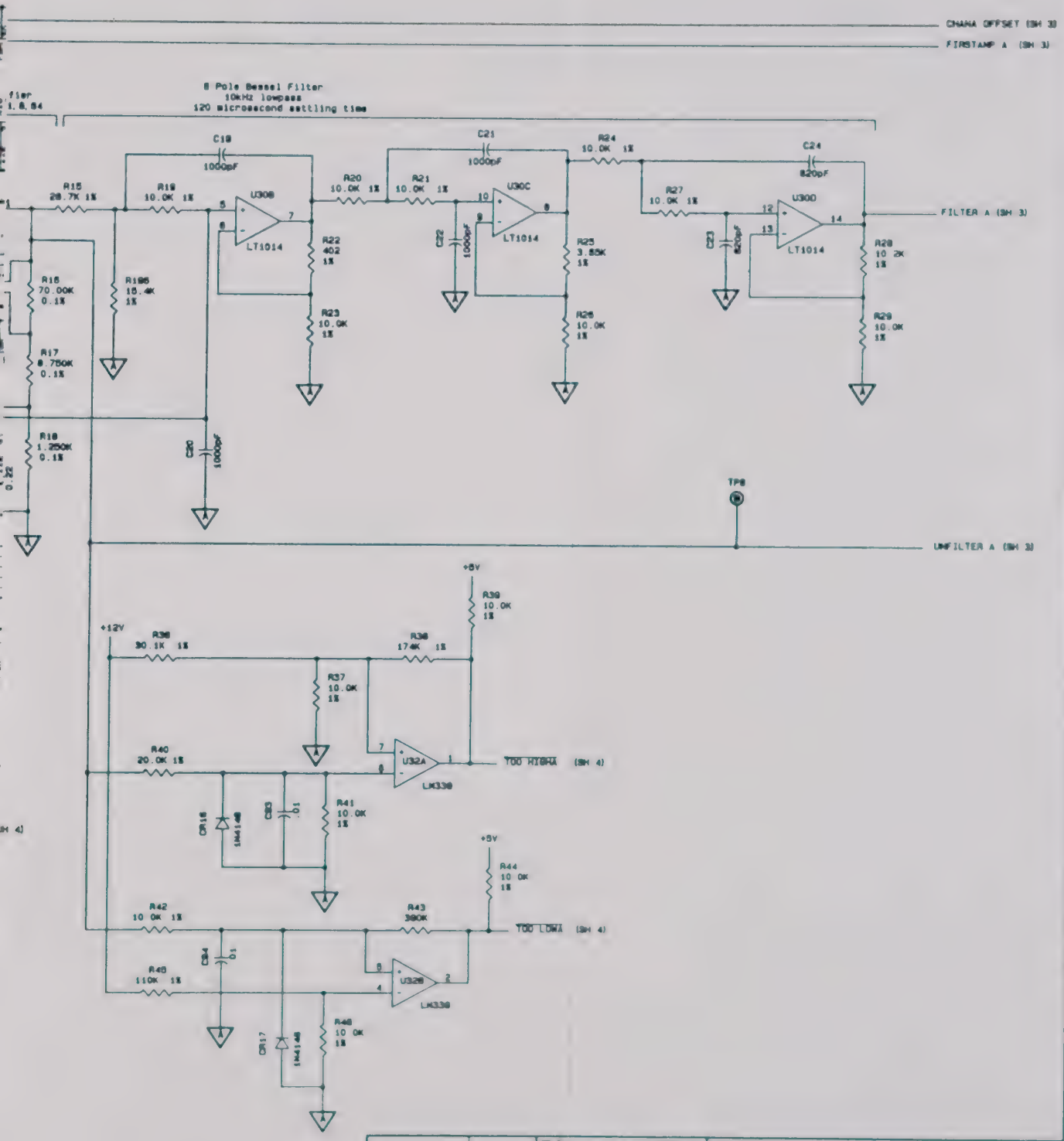


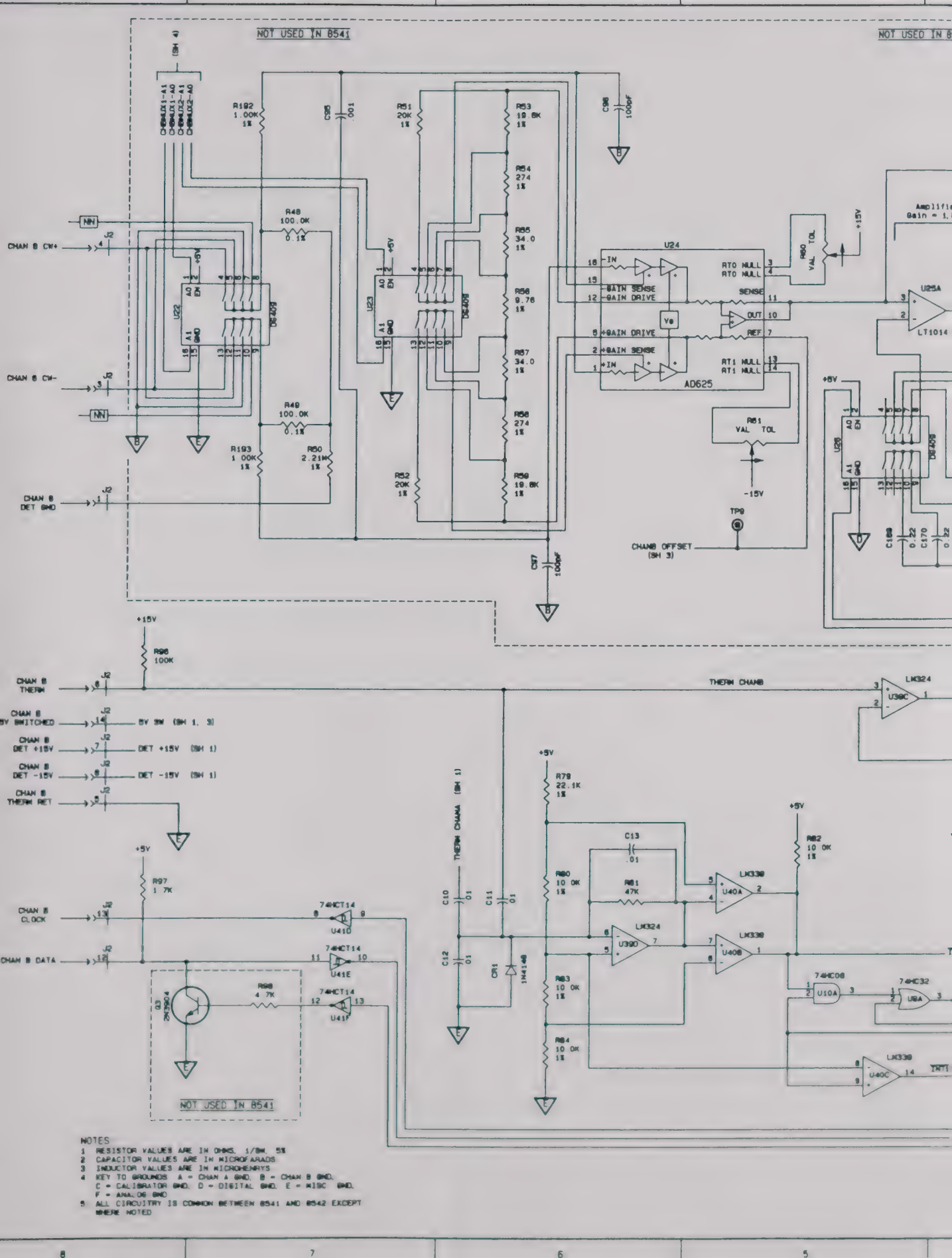
Figure 8-2. Analog PC Board Assembly (A2) #21181

COMPONENT LOCATION TABLE																							
CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC
A1	B2	C64	D4	C126	J8	CR1	E7	R1	C7	R69	D6	R137	E5	R183	E2	TP1	F1	U1	G6				
		C65	D4	C127	J7	CR2	H6	R2	C7	R70	D6	R138	E5	R184	E3	TP2	F2	U2	G7				
C4	G6	C66	D4	C128	G7	CR3	H5	R3	C7	R71	D6	R139	E5	R185	E3	TP3	F3	U3	G8				
C5	G5	C67	D4	C129	L8	CR4	F5	R4	D7	R72	D6	R140	E5	R186	E3	TP4	F4	U4	H1				
C6	G5	C68	C4	C130	F3	CR5	F5	R5	D8	R73	D6	R141	E5	R187	D2	TP5	J7	U5	H2				
C7	H5	C69	B5	C131	F4	CR6	F4	R6	D7	R74	D6	R142	E5	R190	C7	TP6	J6	U6	H3				
C8	F5	C70	D4	C132	E3	CR7	F4	R7	D7	R75	D6	R143	E5	R191	C7	TP7	J5	U7	H4				
C9	F6	C71	C5	C133	E4	CR8	B4	R8	D7	R76	D6	R144	E5	R192	C6	TP8	J4	U8	H5				
C10	D9	C72	D4	C134	F2	CR9	B4	R9	E7	R77	D6	R145	E5	R193	C6	TP9	J3	U9	H6				
C11	D8	C73	D5	C135	G3	CR10	B4	R10	D8	R78	D6	R146	E5	R194	C8	TP10	J2	U10	H7				
C12	E8	C74	D4	C136	H2			R11	C8	R79	D6	R147	E5	R195	C8	TP11	J1	U11	H8				
C13	D9		D5	C137	H3	CR11	C5	R12	C8	R80	D6	R148	E5	R196	H8	TP12	J8	U12	J1				
C14	B5	C75	D4	C138	F2	CR12	C4	R13	E8	R81	D6	R149	E5	R197	H6	TP13	J7	U13	J2				
C15	C5	C76	D5	C139	F2		C5	R14	E7	R82	D6	R150	D5	R198	K5	TP14	J6						
C17	C9	C77	A3	C140	E4	CR13	B4	R15	E8	R83	D6	R151	D5	R199	D5								
C18	C8	C78	A2	C141	E4	CR14	D4	R16	H8	R85	C6	R152	E5	R204	E7								
C19	G8	C79	A4	C142	G2	CR15	C5	R17	H8	R86	E6	R153	E5	R205	E8			U1	G6				
C20	G8	C80	D3	C143	G2	CR16	I7	R18	H8	R87	C8	R154	D4	R206	F8			U2	G7				
C21	G7	C81	E2	C144	E5	CR17	I8	R19	G8	R78	C8	R146	D4	R207	F7			U3	G8				
C22	H7	C82	E2	C145	E5	CR18	I6	R20	G8	R79	E8	R147	E4	R218	E6	U1	F6	U4	H1				
C23	F8	C83	E2	C146	E2	CR19	I6	R21	G7	R80	E8	R148		R219	E6	U2	F7	U5	H2				
C24	F7		F2	C147	E2	CR20	D3	R22	G8	R81	D8	R149		R220	F6			U6	H3				
C25	L6	C84	E4	C148	H8			R23	G8	R82	E8	R150	D5	R221	F5	U3	F8	U7	H4				
C26	L7	C85	D1	C149	I2			R24	G7	R83	E8	R151	D4	R228	L7	U4	H1	U8	H5				
C27	K7	C86	D2	C150	H2	J1	B7	R25	G7	R84	E8	R152	B4	R229	K7	U5	I1	U9	H6				
C28	K7	C87	E2	C151	I3	J2	B6	R26	G7	R85	H6	R153	B4	R232	F3	U6	I2						
C29	J7	C88	G2	C152	I3	J3	L6	R27	G7	R86	I6	R154	B4	R233	F4	U7	I3	U11	H8				
C30	J7	C90	E7	C153	J7	J4	L7	R28	G7	R87	I7	R155	B4	R234	G2	U8	I4						
C31	J7	C91	E8	C154	I4	J5	E5	R29	F7	R88	H7	R156	B4	R235	G3	U9	I5						
C33	L8	C92	E7	C155	L5			R30	B8	R89	I7		B5	R240	F5		H3						
C34	G3	C93	I7	C156	K5			R31	A8	R90	I7	R157	B4	R241	F4	U8	H3						
C35	F3	C94	I7	C157	G4	L11	D3		A9	R91	I6	R158	B5	R242	F2		I3						
C36	E4	C95	E6	C158	F5	L12	D3	R32	A8	R92	I7	R159	B5	R243	G2	U10	I3						
C37	G3	C96	E6	C159	G4	L13	C3		A9	R93	H7	R160	C4	R246	F1		I3						
C38	H2	C97	E6	C160	F4	L14	B3	R33	H9	R94	I6	R161	B4	R247	E2	U11	I3						
C39	G1	C98	I7	C161	H1	L15	B2	R34	C8	R95	I6	R162	B5	R248	G2	U12	I3						
C40	H3	C99	I7	C162	H2		C2	R35	G9	R96	D8	R163	C4	R249	H2	U13	G3						
C41	K5	C100	B7	C163	I2	L16	B2	R36	I8	R97	I8		C5	R250	J8	U14	H3						
C42	K5	C101	B8	C164	I2		C2	R37	I8	R98	H8	R164	D4	R251	F5		I3						
C43	K6	C102	D7	C165	L5	L17	A3	R38	I7	R99	L5	R165	C5			U15	I3						
C44	K6	C103	C8	C166	M5	L18	B1	R39	H8	R100	L7	R166	C5				J3						
C45	K5	C104	F7	C167	H7		C1	R40	I7	R101	K7	R167	C5			U16	I4						
C46	K5	C105	F8	C168	H7			R41	I7	R102	K7	R168	D4				J4						
C47	E3	C106	G8	C167	H5			R42	I8	R103	K7	R169	D4	RP1	B3	U17	F4						
C48	E4	C107	G7	C170	H5	P1	I6	R43	I7	R104	K7		C5	RP2	H4		I4						
C49	D2	C108	H7	C171	J6		J6	R44	H8	R105	J7	R170	C5	RP3	L6	U18	J4						
C50	D3	C109	H8	C172	I6		K6	R45	I8	R107	L6	R171	B4				J5						
C51	D3	C110	I7	C173	K7			R46	I8	R108	L7	R172	C5			U19	F5						
C52	C3	C112	D9	C174	J7			R48	C6	R113	F3	R173	B7	RP1	B8	U20	F6						
C53	D3	C114	B6	C175	C5	Q1	B8	R49	C6	R114	F3	R174	C1	RP2	I4		I5						
C54	D2	C115	B6	C176	C5	Q2	C9	R50	C6	R115	G3		C1	RP3	K6	U21	H4						
C55	C3	C116	D6			Q3	C8	R51	D8	R116	G3	R175	B1				H5						
C56	C3	C117	D6			Q4	D3	R52	D6	R117	F3	R176	B1	R14	B7		I4						
C57	B3	C118	F6			Q5	D1	R53	D6	R118	G3	R177	C1				I5						
C58	D3	C119	F6			Q6	E1	R54	D6	R114	H1	R178	C4										
C59	D2	C120	G6			Q7	A2	R55	D6	R170	H1	R179	B1										
C60	C2	C121	G5					R56	E6	R181	I1	R180	B1										
C61	B4	C122	H6					R57	D7	R182	I1	R181	B1										
C62	B4	C123	H6					R58	D8	R174	H1	R182	B1										
C63	B3	C124	F1					R59	D8	R184	I2	R183	B1										


CHAN A CH+
CHAN A CH-
CHAN A DET GND
CHAN A 5V SWITCHED
CHAN A DET +15V
CHAN A DET -15V
CHAN A THERM RET
CHAN A THERM
CHAN A CLOCK
CHAN A DATA
AD625
LM324
74HCT14
DS2409
2N3904
MJE170
DET +15V (SH 2)
DET -15V (SH 2)
5V SW (SH 2, 3)
THERM CHANA (SH 2)
THERMA (SH 3)
CLOCKA (SH 4)
DATA IN A (SH 4)
DATA OUT A (SH 4)
CHAMUX3-A0
CHAMUX3-A1
5V SWITCHED
HOLD @ 0.5A)
NOTES
1. RESISTOR VALUES ARE IN OHMS, 1/8W, 5%
2. CAPACITOR VALUES ARE IN MICROFARADS
3. INDUCTOR VALUES ARE IN MICROHENRYS
4. KEY TO GROUNDS: A = CHAN A GND, B = CHAN B GND,
C = CALIBRATOR GND, D = DIGITAL GND, E = MISC GND,
F = ANALOG GND
5. THE FOLLOWING COMPONENTS ARE NOT LOADED ON THE PC BOARD: R3, R13, R14,
C167, C168, R50, R80, R81, C169, C170, AND C12
6. ALL CIRCUITRY IS COMMON BETWEEN 8541 AND 8542 EXCEPT WHERE NOTED



	DR BY J BAUER	DATE 2/25/91	ANALOG PC BOARD (CHANNEL A)
	CHK BY		
	ENGR R BUTTERWORTH		
	MFG		
NEXT ASSY	USED ON	SIZE D	DRAWING NO 21182 REV 11
APPLICATION	DO NOT SCALE DRAWING	SCALE NONE	SHEET 1 OF 8


NOT USED IN 8541
NOT USED IN 8
CHAN B CW+
CHAN B CW-
CHAN B DET GND
R192 1.00K 1%
R193 1.00K 1%
R48 100.0K 0.1%
R49 100.0K 0.1%
R50 2.21K 1%
R51 20K 1%
R52 20K 1%
R53 19.6K 1%
R54 274 1%
R55 34.0 1%
R56 9.76 1%
R57 34.0 1%
R58 274 1%
R59 19.6K 1%
C95 .001
C96 100pF
C97 100pF
U22
U23
DG409
U24
AD625
-IN
+IN
-GAIN SENSE
-GAIN DRIVE
+GAIN DRIVE
+GAIN SENSE
RTO NULL
SENSE
OUT
REF
RT1 NULL
R60 VAL TOL
R61 VAL TOL
+15V
-15V
TP9
CHANB OFFSET (SH 3)
U25A
LT1014
U26
C169
C170
THERM CHANB
CHAN B THERM
CHAN B 5V SWITCHED
CHAN B DET +15V
CHAN B DET -15V
CHAN B THERM RET
5V SW (SH 1, 3)
DET +15V (SH 1)
DET -15V (SH 1)
R96 100K
LM324
U39C
R97 1.7K
CHAN B CLOCK
CHAN B DATA
74HCT14
U41D
U41E
U41F
Q3 2N3904
R98 4.7K
NOT USED IN 8541
THERM CHANA (SH 1)
C10 .01
C11 .01
C12 .01
CR1 1N4148
R78 22.1K 1%
R79 10.0K 1%
R80 10.0K 1%
R81 47K
R82 10.0K 1%
R83 10.0K 1%
R84 10.0K 1%
C13 .01
U40A
U40B
U40C
U39D
74HC08
74HC32
U10A
U8A
INT1
NOTES
1 RESISTOR VALUES ARE IN OHMS, 1/8W, 5%
2 CAPACITOR VALUES ARE IN MICROFARADS
3 INDUCTOR VALUES ARE IN MICROHENRYS
4 KEY TO GROUNDS A = CHAN A GND, B = CHAN B GND,
C = CALIBRATOR GND, D = DIGITAL GND, E = MISC GND,
F = ANALOG GND
5 ALL CIRCUITRY IS COMMON BETWEEN 8541 AND 8542 EXCEPT
WHERE NOTED

NOT USED IN 8541

FIRSTAMP B (SH 3)

8 Pole Bessel Filter
10kHz lowpass
120 microsecond settling time

C4 1000pF
R62 26.7K 1%
R66 10.0K 1%
U25B LT1014
R67 10.0K 1%
R68 402 1%
R69 10.0K 1%
R197 15.4K 1%
R63 70.00K 0.1%
R64 8.750K 0.1%
R65 1.250K 0.1%
C5 1000pF

C6 1000pF
R70 10.0K 1%
U25C LT1014
C7 1000pF
R72 3.85K 1%
R73 10.0K 1%

R71 10.0K 1%
C8 820pF
R74 10.0K 1%
U25D LT1014
C9 820pF
R75 10.2K 1%
R76 10.0K 1%

FILTER B (SH 3)

TP10

UNFILTER B (SH 3)

CHSMUX3-A1 (SH 4)
CHSMUX3-A0 (SH 4)
THERMB (SH 3)

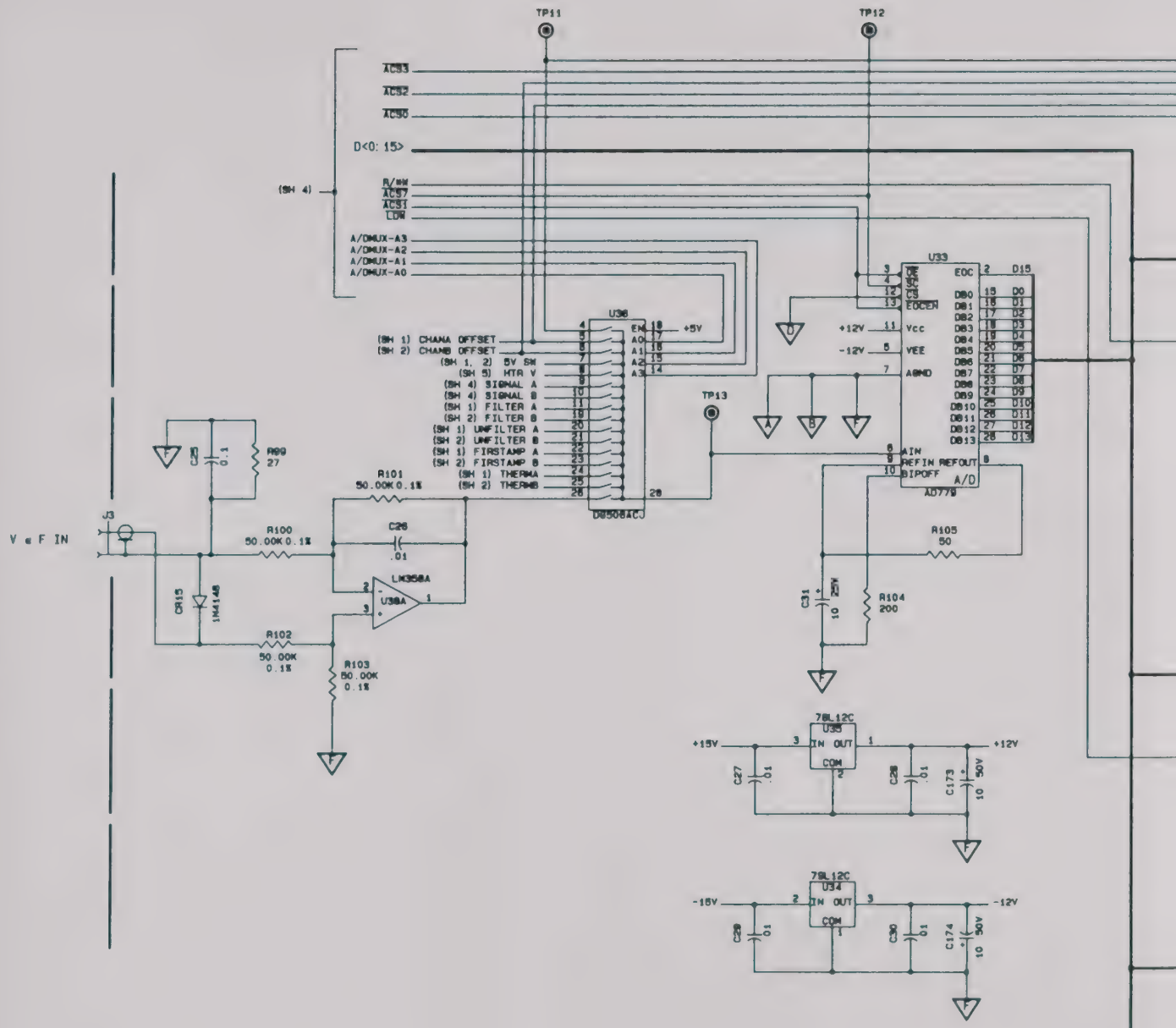
+12V
R60 30.1K 1%
R65 10.0K 1%
R77 10.0K 1%
R78 10.0K 1%
R66 20.0K 1%
+5V
R66 10.0K 1%
R67 174K 1%
U32C LM339
TOO HIGHB (SH 4)
CR16 1N4148
C66 .01
R80 10.0K 1%
+5V
R83 10.0K 1%
R81 10.0K 1%
R82 390K
TOO LOWB (SH 4)
C65 .01
R84 110K 1%
U32D LM339
CR18 1N4148
R85 10.0K 1%

TPERB (SH 4)
ENAB (SH 4)
(SENSOR CHANGE)

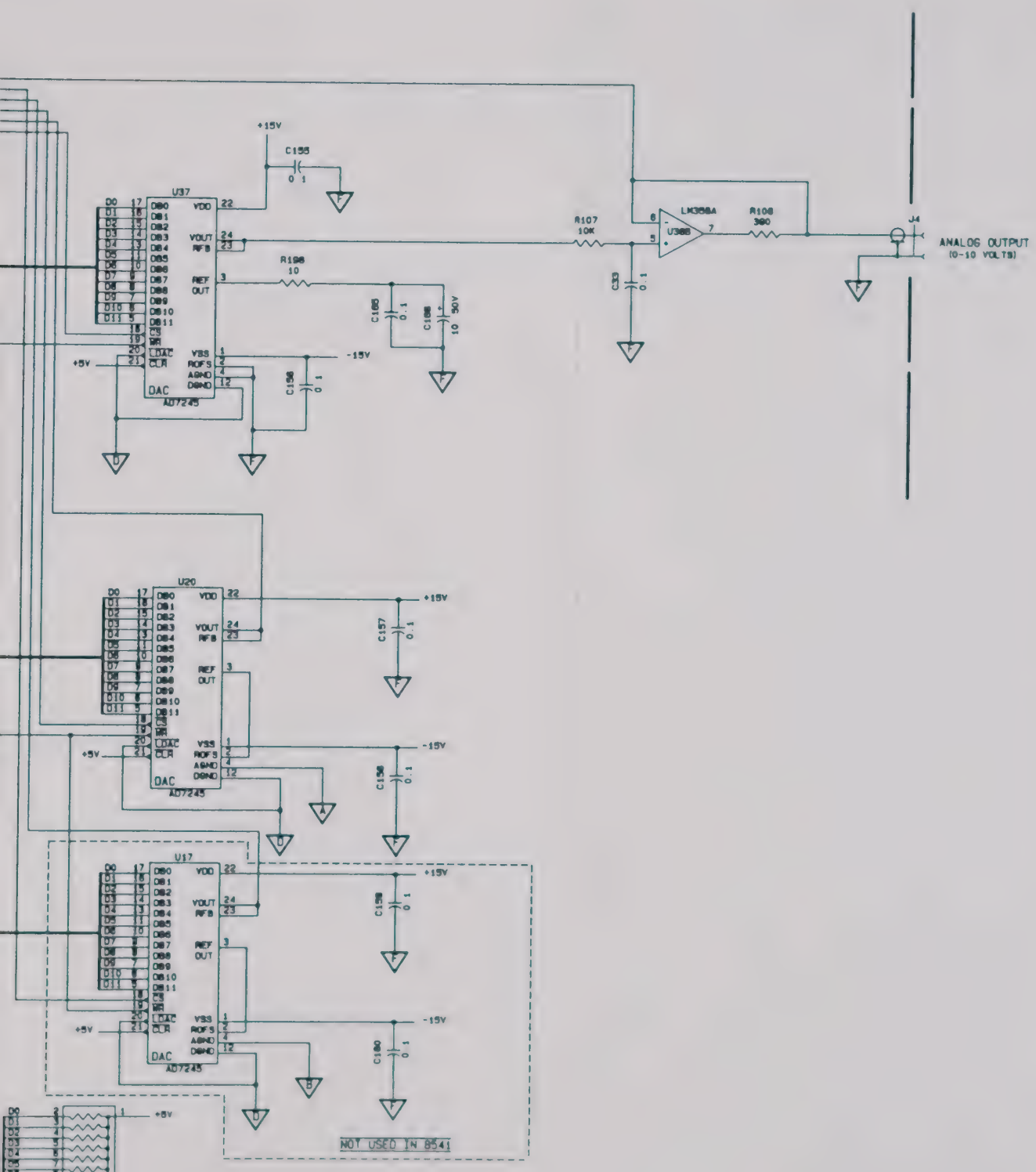
P1 33 TRT1 (CPU BD)

CLOCKB
DATA IN B
DATA OUT B
(SH 4)

DR BY J. BAUER	DATE 2/25/91	
CHK BY		
ENGR M. BUTTERWORTH		ANALOG PC BOARD (CHANNEL B)
MFG		
NEXT ASSY	USED ON	SIZE D — DRAWING NO 21182 — REV 11
APPLICATION	DO NOT SCALE DRAWING	SCALE N/A — SHEET 2 OF 8



NOTES
1. RESISTOR VALUES ARE IN OHMS, 1/8W 5%
2. CAPACITOR VALUES ARE IN MICROFARADS
3. INDUCTOR VALUES ARE IN MICROHENRYS
4. KEY TO GROUNDS A = CHAN A GND, B = CHAN B GND
   C = CALIBRATOR GND, D = DIGITAL GND, E = MISC GND
   F = ANALOG GND
5. ALL CIRCUITRY IS COMMON BETWEEN 8541 AND 8542
   EXCEPT WHERE NOTED

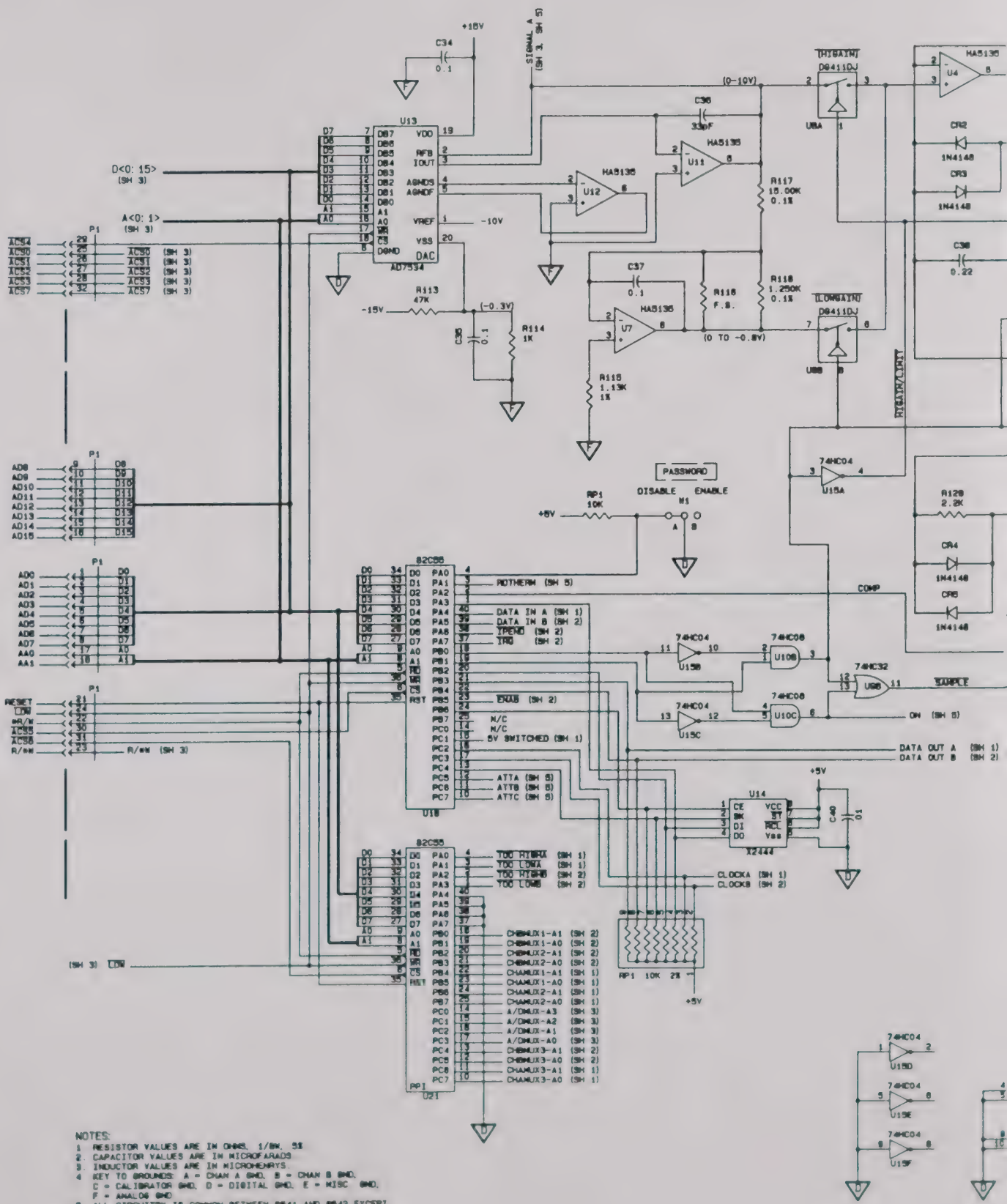


		DR BY J BAUER	DATE 2/25/91
		CHK BY	
		ENGR R BUTTERWORTH	
		MFG	
NEXT ASSY	USED ON	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	SIZE D
APPLICATION		DO NOT SCALE DRAWING	SCALE N/A

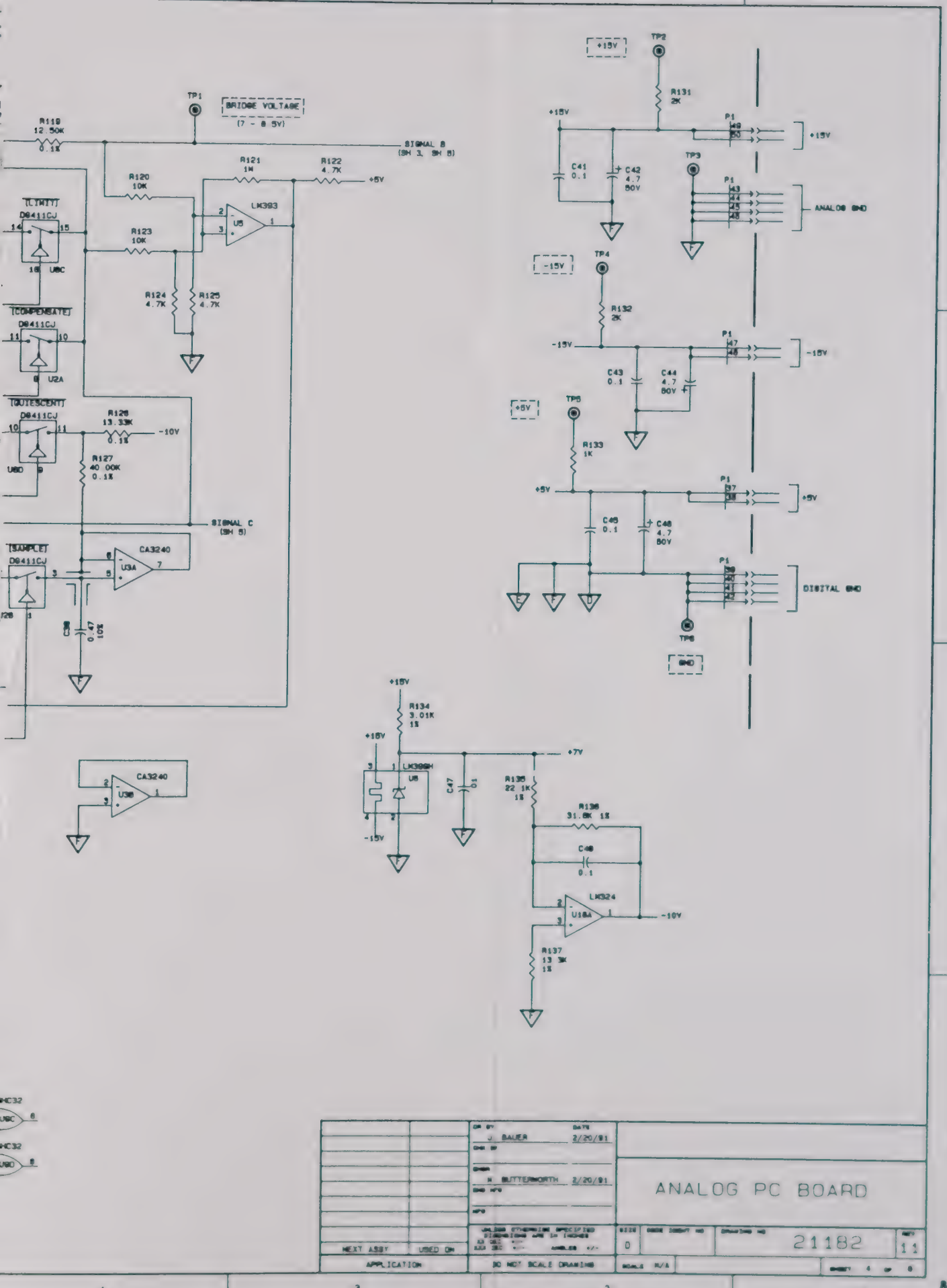
ANALOG PC BOARD

DRAWING NO 21182 REV 11

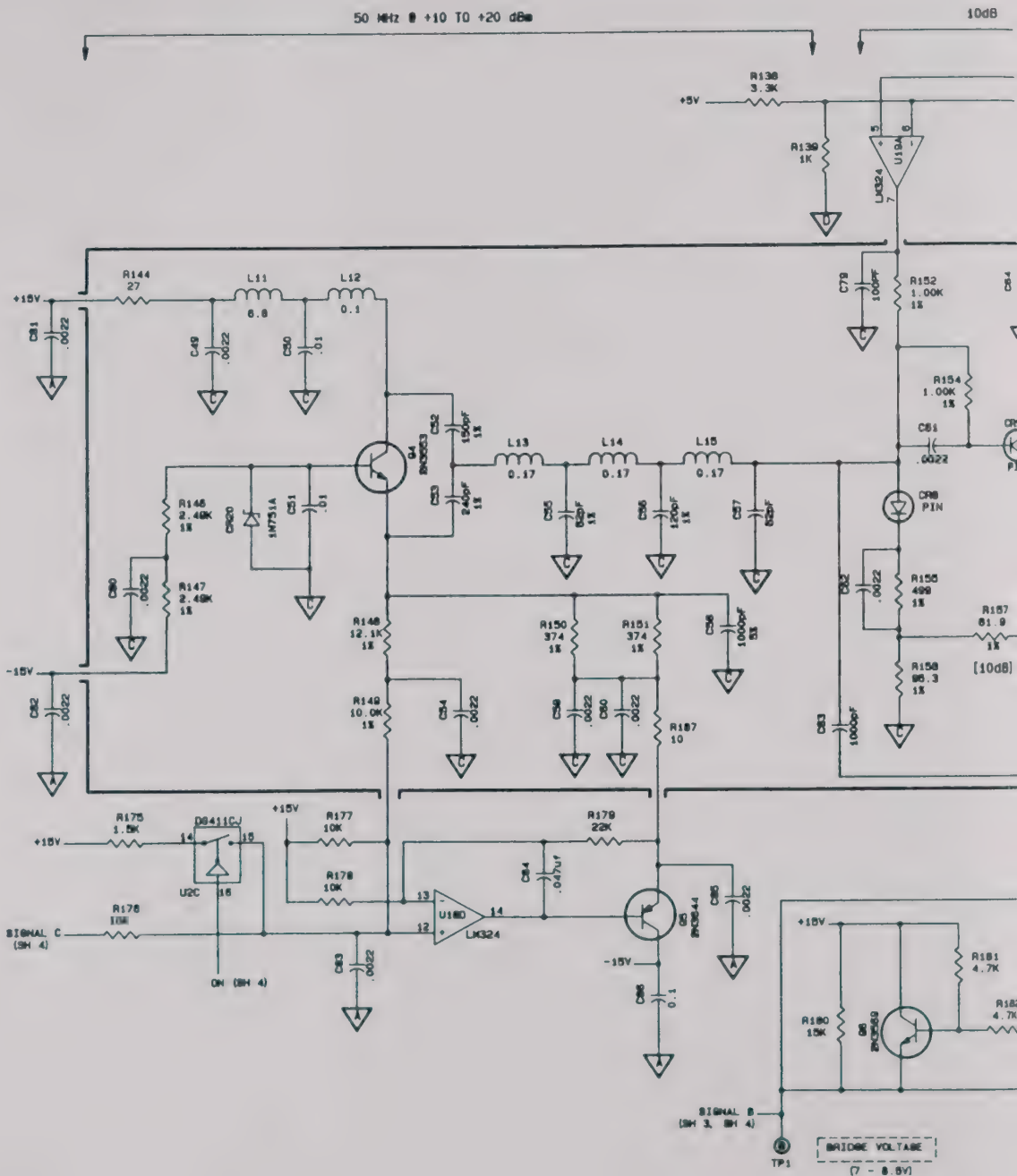
SHEET 3 OF 8



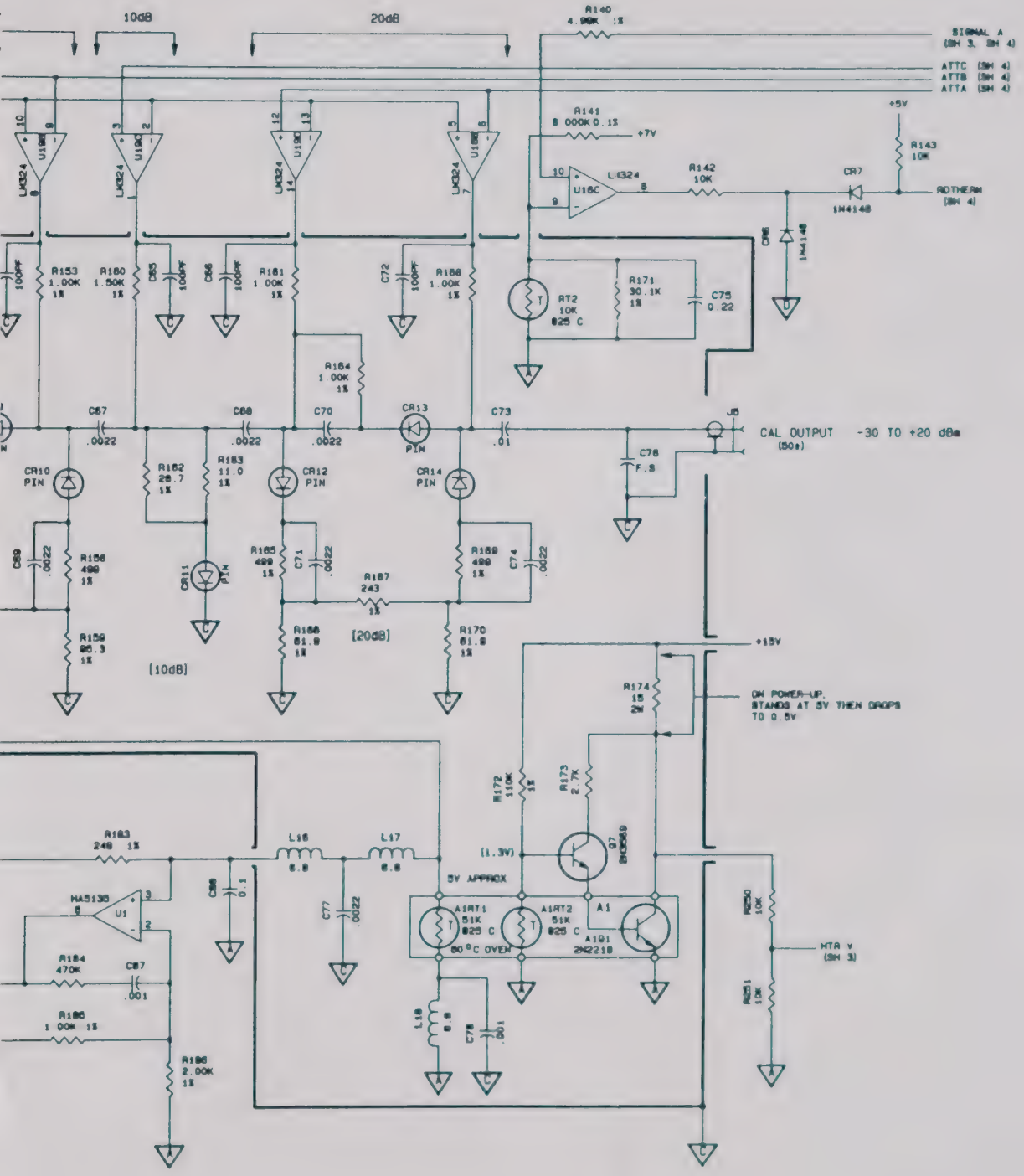
NOTES:
1. RESISTOR VALUES ARE IN OHMS, 1/8W, 5%
2. CAPACITOR VALUES ARE IN MICROFARADS
3. INDUCTOR VALUES ARE IN MICROHENRYS.
4. KEY TO GROUNDS: A = CHAN A GND, B = CHAN B GND, C = CALIBRATOR GND, D = DIGITAL GND, E = MISC GND, F = ANALOG GND
5. ALL CIRCUITRY IS COMMON BETWEEN 8541 AND 8542 EXCEPT WHERE NOTED



		J. BAUER 2/20/91	ANALOG PC BOARD
		N. BUTTERWORTH 2/20/91	
NEXT ASSY	USED ON		SIZE D — 21182 — REV 11
APPLICATION		DO NOT SCALE DRAWING	SCALE N/A — SHEET 4 OF 8



NOTES
1. RESISTOR VALUES ARE IN OHMS, 1/8W, 5%
2. CAPACITOR VALUES ARE IN MICROFARADS
3. INDUCTOR VALUES ARE IN MICROHENRYS.
4. KEY TO GROUNDS: A = CHAN A GND, B = CHAN B GND, C = CALIBRATOR GND, D = DIGITAL GND, E = MISC. GND, F = ANALOG GND
5. ALL CIRCUITRY IS COMMON BETWEEN 8641 AND 8642 EXCEPT WHERE NOTED



		DR BY J BAJER DATE 2/20/91	ANALOG PC BOARD (CALIBRATOR CIRCUIT)
		CHK BY	
		ENGR M BUTTERWORTH 2/20/91	
		MFG	
NEXT ASSY	USED ON	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES FRACT ±/- DEC ±/- ANGLES ±/-	SIZE D · DRAWING NO 21182 · REV 11
APPLICATION		DO NOT SCALE DRAWING	SCALE N/A · SHEET 8 OF 8

NOTES

1. RESISTOR VALUES ARE IN OHMS, 1/8W, 5%
2. CAPACITOR VALUES ARE IN MICROFARADS.
3. INDUCTOR VALUES ARE IN MICROHENRYS.
4. KEY TO GROUND: A = CHAN A GND. B = CHAN B GND.
   C = CALIBRATOR GND. D = DIGITAL GND. E = MISC GND.
   F = ANALOG GROUND.
5. ALL CIRCUITRY IS COMMON BETWEEN 8541 AND 8542 EXCEPT WHERE NOTED.

NEXT ASSY	USED ON

APPLICATION

DO NOT SCALE DRAWING

DWN BY	J. BAUER	9/9/91
CHK BY		
ENGR		
ENG MFG		
MFG		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
XX DEC +/- .1 XXX DEC +/- .05 ANGLES +/-

SIZE	DRAWING NO	REV
D	21182	11

ANALOG PC BOARD

SHEET 8 OF 8 SHEETS

+15V

-15V

U1 DB408 U2 DB408 U3 7406 U4 7406 U5 7406 U6 DB408 U7 7414

U8 LM324 U9 LM324 U10 LM324 U11 LM324 U12 LM324 U13 DB411 U14 DB411

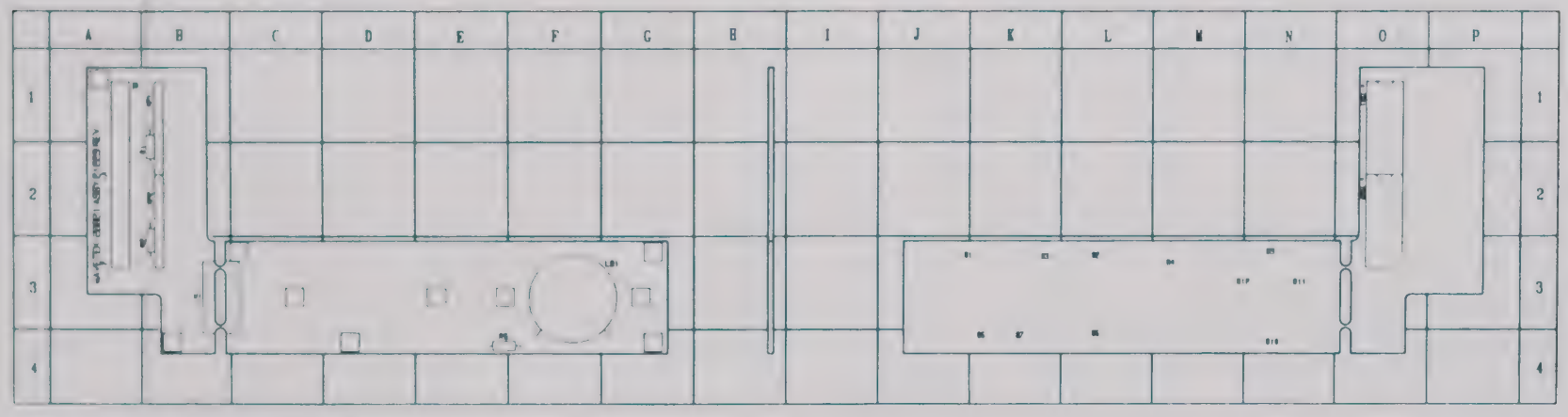
U15 LM324 U16 LM324 U17 LM324 U18 LM324 U19 LM324 U20 LM324 U21 LM324

U22 DB408 U23 DB408 U24 AD625 U25 MC34074 U26 DB408 U27 DB408 U28 AD625

U29 MC34074 U30 LM324 U31 DB408 U32 LM324 U33 AD779 U34 DB506 U35 LM324

U36 LM324 U37 DB506 U38 LM324 U39 LM324 U40 LM324

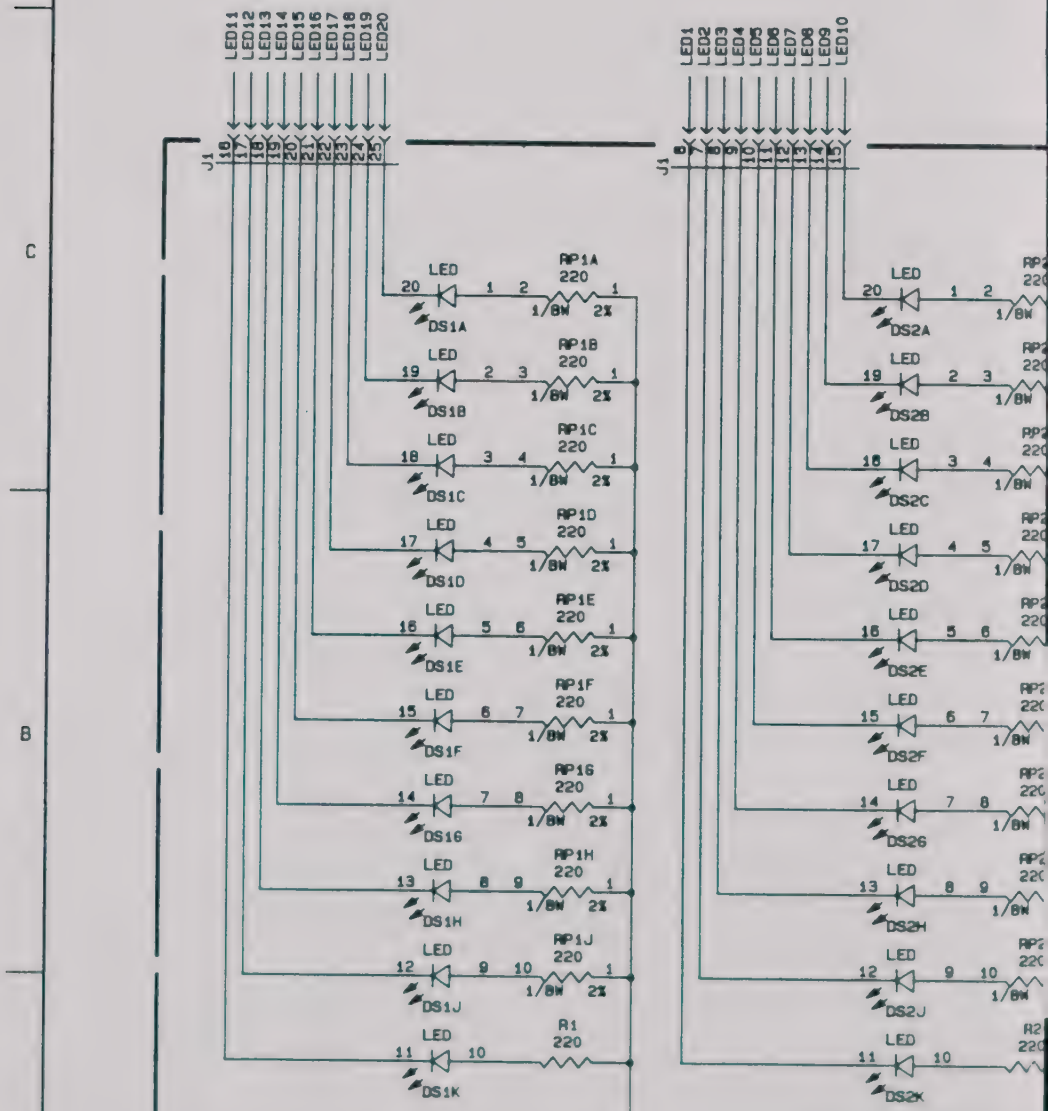
NOT USED IN 8541



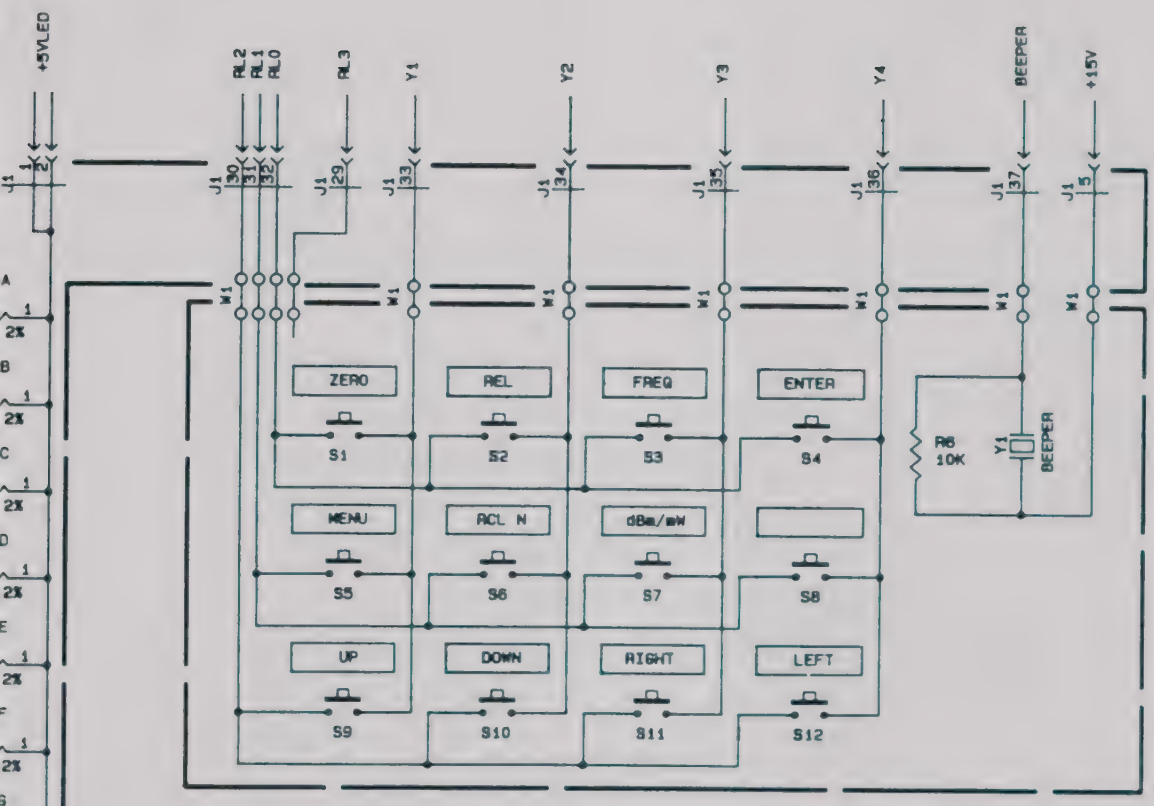
COMPONENT LOCATION TABLE

CKT REF	GRID LOC	CKT REF	GRID LOC	CKT REF	GRID LOC
				RP1	B-1
				RP2	B-1

Figure 8-3. Front Panel PC Board Assembly (A3) #21229



NOTES (UNLESS OTHERWISE SPECIFIED):
1. RESISTOR VALUES ARE IN OHMS, 1/4W, 5%



		DR BY J. BAUER DATE 2/4/91	WAVETEK MICROWAVE, INC
		CHK BY	
		ENGR M. BUTTERWORTH 2/4/91	FRONT PANEL
		ENG MFG	
		MFG	
NEXT ASSY	USED ON	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES .XX DEC +/- .XXX DEC +/- ANGLES +/-	SIZE C / CODE IDENT NO / DRAWING NO 21230 / REV 2
APPLICATION		DO NOT SCALE DRAWING	SCALE 0 / SHEET 1 OF 1

2 - 9/30/91
1 - 5/1/91

CHAPTER 9

REPLACEABLE PARTS LISTINGS

Description	Page No.
Model 8541 Power Meter Mainframe Assembly #21330	9-2
Model 8542 Power Meter Mainframe Assembly #21195	9-2
CPU PC Board Assembly #21095 (Board #A1)	9-3
8541 Analog PC Board Assembly #21181-001 (Board #A2)	9-7
8542 Analog PC Board Assembly #21181 (Board #A2)	9-15
Front Panel PC Board Assembly #21229 (Board #A3)	9-24

Note 1: The Model 8541 single channel and the Model 8542 dual channel power meters use different Analog PC Boards. See above for the location of the parts listing for your specific instrument.

Note 2: The LCD Display Assembly (A4) contains no user replaceable parts. If this component needs to be replaced, order Wavetek Assembly Number 21240.

MODEL 8541 - POWER METER #21330

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A1	21095	CPU PCB ASSY	WAVETEK MICROWAVE	WMI 21095
A2	21181-001	PCB ASSY, ANALOG 8541	WAVETEK MICROWAVE	WMI 21181
A3	21229	FRONT PANEL PCB ASSY	WAVETEK MICROWAVE	WMI 21229
A4	21240	LCD DISPLAY ASSY	WAVETEK MICROWAVE	WMI 21240
F1	10064-009	FUSE GLAS TUBE SLOBLO 1A 250V	LITTLEFUSE	313001/S
F2	10064-009	FUSE GLAS TUBE SLOBLO 1A 250V	LITTLEFUSE	313001/S
RT1	20033	VARISTOR MET OXIDE DISC 275V	GENERAL ELECTRIC CO.	V275LA40B
W2	21217	CABLE ASSY,CPU-FR PNL	WAVETEK MICROWAVE	WMI 21217
W3	21175-002	CABLE ASSY,CPU-GPIB	WAVETEK MICROWAVE	WMI 21175-002
W4	21198	CABLE ASSY,CAL	WAVETEK MICROWAVE	WMI 21198
W5	21199	CABLE ASSY, SENSOR INPUT	WAVETEK MICROWAVE	WMI 21199

MODEL 8542 - POWER METER #21195

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A1	21095	CPU PCB ASSY	WAVETEK MICROWAVE	WMI 21095
A2	21181	PCB ASSY,ANALOG	WAVETEK MICROWAVE	WMI 21181
A3	21229	FRONT PANEL PCB ASSY	WAVETEK MICROWAVE	WMI 21229
A4	21240	LCD DISPLAY ASSY	WAVETEK MICROWAVE	WMI 21240
F1	10064-009	FUSE GLAS TUBE SLOBLO 1A 250V	LITTLEFUSE	313001/S
F2	10064-009	FUSE GLAS TUBE SLOBLO 1A 250V	LITTLEFUSE	313001/S
RT1	20033	VARISTOR MET OXIDE DISC 275V	GENERAL ELECTRIC CO.	V275LA40B
W2	21217	CABLE ASSY,CPU-FR PNL	WAVETEK MICROWAVE	WMI 21217
W3	21175-002	CABLE ASSY,CPU-GPIB	WAVETEK MICROWAVE	WMI 21175-002
W4	21198	CABLE ASSY,CAL	WAVETEK MICROWAVE	WMI 21198
W5	21199	CABLE ASSY, SENSOR INPUT	WAVETEK MICROWAVE	WMI 21199

CPU PC BOARD ASSEMBLY #21095

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A1C1	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C2	19598-006	CAP ELCTLT 100UF 20% 25V RDL	NICHICON (AMERICA) CORP.	ULB1E101MAA
A1C3	19599-001	CAP ELCTLT RDL 10uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H100MAA
A1C4	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C5	19599-001	CAP ELCTLT RDL 10uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H100MAA
A1C6	19803-002	CAP,ELCTLT,RDL,4700uF,20%,16V	NICHICON (AMERICA) CORP.	UVX1C472MHA
A1C7	11501-005	CAP CER 0.47UF 20% 50V	ERIE TECHNOLOGICAL	8131-050-Z5U-474M
A1C8	11501-005	CAP CER 0.47UF 20% 50V	ERIE TECHNOLOGICAL	8131-050-Z5U-474M
A1C9	19598-005	CAP ELCTLT RDL 2200uF 20% 25V	NICHICON (AMERICA) CORP.	ULB1E222MRA
A1C10	11501-005	CAP CER 0.47UF 20% 50V	ERIE TECHNOLOGICAL	8131-050-Z5U-474M
A1C11	11501-005	CAP CER 0.47UF 20% 50V	ERIE TECHNOLOGICAL	8131-050-Z5U-474M
A1C12	19598-005	CAP ELCTLT RDL 2200uF 20% 25V	NICHICON (AMERICA) CORP.	ULB1E222MRA
A1C13	11501-005	CAP CER 0.47UF 20% 50V	ERIE TECHNOLOGICAL	8131-050-Z5U-474M
A1C14	11501-005	CAP CER 0.47UF 20% 50V	ERIE TECHNOLOGICAL	8131-050-Z5U-474M
A1C15	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C16	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C17	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C18	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C19	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C20	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C21	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C22	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C23	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C24	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C25	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C26	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C27	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C28	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C29	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C30	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C31	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C32	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C33	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C34	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C35	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C36	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C37	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C38	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C39	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C40	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C41	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C42	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C43	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C44	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C45	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C46	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C47	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C48	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C49	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C50	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C51	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C52	11501-005	CAP CER 0.47UF 20% 50V	ERIE TECHNOLOGICAL	8131-050-Z5U-474M
A1C53	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A1C54	19803-002	CAP,ELCTLT,RDL,4700uF,20%,16V	NICHICON (AMERICA) CORP.	UVX1C472MHA
A1CR1	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A1CR2	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A1CR3	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A1CR4	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A1CR5	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A1CR6	12409	RECTIFIER FULL WAVE BRIDGE	ELECTRONIC DEVICES, INC.	PE10
A1CR7	20016	RECTIFIER BRIDGE DIP 1A VM28	VARO	VM28
A1DS1	17206-001	LED, ULTRA-BRIGHT YELLOW	HEWLETT PACKARD	HLMP-1440S02
A1DS2	17206-001	LED, ULTRA-BRIGHT YELLOW	HEWLETT PACKARD	HLMP-1440S02
A1J1	21168	CONN,RECP,PC MT,50 POS	AUGAT	A015-050-YE-001
A1J2	14514-001	MOD 2 POST	AUTOSPLICE	8-25304432
A1J3	14514-001	MOD 2 POST	AUTOSPLICE	8-25304432
A1J4	21164	CONN,BNC,RT ANG,PC MTG	AMP INC.	413524-1
A1J5	21164	CONN,BNC,RT ANG,PC MTG	AMP INC.	413524-1
A1J6	19477-011	CONN,HDR,POST,STR,LOCK,16 POS	AMP, INC.	1-640456-6
A1J7	21164	CONN,BNC,RT ANG,PC MTG	AMP INC.	413524-1
A1J8	16570	HEADER DOUBLE ROW 50 POS	AMP, INC.	2-87227-5
A1J9	19183-001	CONN HDR HSG MATE-N-LOK 6PINS	AMP, INC.	1-380999-0
A1J10	14514-001	MOD 2 POST	AUTOSPLICE	8-25304432
A1J11	19477-003	CONN HDR POST STR LOCK 4POS	AMP, INC.	640456-4
A1Q1	13634	TRANSISTOR 2N3904	FAIRCHILD	2N3904
A1R1	10013-033	RES DEP CARB 4.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R2	10013-096	RES DEP CARB 20K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R3	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R4	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R5	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R6	10013-017	RES DEP CARB 220 OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R7	10013-033	RES DEP CARB 4.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R8	10013-033	RES DEP CARB 4.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R9	10013-033	RES DEP CARB 4.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R10	10013-017	RES DEP CARB 220 OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R11	10013-021	RES DEP CARB 470 OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R12	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R13	10013-021	RES DEP CARB 470 OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R14	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R16	21156	RES,VAR,1T,20K,20%	PIHER INTERNATIONAL	PT15WB20KA-2
A1R17	10013-045	RES DEP CARB 47K OHM 5% 1/4W	MEPCO/ELECTRA	CR25 47K 5%
A1R18	10013-033	RES DEP CARB 4.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R19	10013-013	RES DEP CARB 100 OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R20	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R21	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R22	10013-049	RES DEP CARB 100K OHM 5% 1/4W	MEPCO/ELECTRA	CR25 100K 5%
A1R23	10013-049	RES DEP CARB 100K OHM 5% 1/4W	MEPCO/ELECTRA	CR25 100K 5%
A1R24	10013-049	RES DEP CARB 100K OHM 5% 1/4W	MEPCO/ELECTRA	CR25 100K 5%
A1R25	10013-049	RES DEP CARB 100K OHM 5% 1/4W	MEPCO/ELECTRA	CR25 100K 5%
A1R26	10013-001	RES DEP CARB 10 OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R27	10013-001	RES DEP CARB 10 OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R28	10013-001	RES DEP CARB 10 OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1R29	10013-025	RES DEP CARB 1K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A1RP1	14882-001	RES NETWK 10K OHM 2% 125MW	ALLEN-BRADLEY CO.	110A103
A1RP2	14882-001	RES NETWK 10K OHM 2% 125MW	ALLEN-BRADLEY CO	110A103
A1RP3	14882-001	RES NETWK 10K OHM 2% 125MW	ALLEN-BRADLEY CO.	110A103
A1RP4	14882-001	RES NETWK 10K OHM 2% 125MW	ALLEN-BRADLEY CO.	110A103
A1RP5	14882-001	RES NETWK 10K OHM 2% 125MW	ALLEN-BRADLEY CO.	110A103
A1RP6	14882-001	RES NETWK 10K OHM 2% 125MW	ALLEN-BRADLEY CO.	110A103
A1TP1	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A1TP2	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A1TP3	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A1TP4	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A1TP5	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A1TP6	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A1TP7	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A1TP8	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A1TP9	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A1TP10	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A1TP11	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A1TP12	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A1TP13	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A1TP14	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A1TP15	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A1TP16	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A1TP17	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A1U1	19566-010	IC-DUAL D FF w PRSET & CLEAR	NATIONAL SEMICONDUCTOR	74HC74N
A1U2	19566-029	IC, Counter, Dual 4-Bit Binary	NATIONAL SEMICONDUCTOR	74HC393N
A1U3	21159	IC,PARALLEL INTFC	NEC	uPD71055C
A1U4	21278	PAL,PROG,MODEL 8542	WAVETEK MICROWAVE	WMI 21278
A1U5	21161	IC,SER TIMEKEEPER	DALLAS SC	DS1202
A1U6	17113-001	IC, OCTAL GPIB XCVR	TEXAS INSTRUMENTS	SN75160AN
A1U7	17113-002	IC, OCTAL GPIB XCVR	TEXAS INSTRUMENTS	SN75162AN
A1U8	17114	IC, GPIB CONTROLLER	TEXAS INSTRUMENTS	TMS9914ANL
A1U9	21155	IC,MPU,16 BIT,12 MHz	TOSHIBA AMERICA INC.	TMP68HC000P-12
A1U10	21162	IC,NONVOL CONT	DALLAS SC	DS1210
A1U11	19566-009	IC QUAD 2-INP OR GATE	NATIONAL SEMICONDUCTOR	74HC32N
A1U12	17048-006	IC OCT BUS TRANSCEIVER	TEXAS INSTRUMENTS	SN74HCT245N
A1U13	17048-006	IC OCT BUS TRANSCEIVER	TEXAS INSTRUMENTS	SN74HCT245N
A1U14	17048-015	IC,OCT 3-STATE NONIV BUFFER	MOTOROLA (SPD)	MC74HCT244N
A1U15	19566-014	IC 3 TO 8 LINE DCDR/DMUXR	NATIONAL SEMICONDUCTOR	74HC138N
A1U16	19566-009	IC QUAD 2-INP OR GATE	NATIONAL SEMICONDUCTOR	74HC32N
A1U17	19566-003	IC HEX INV	NATIONAL SEMICONDUCTOR	74HC04
A1U18	19566-014	IC 3 TO 8 LINE DCDR/DMUXR	NATIONAL SEMICONDUCTOR	74HC138N
A1U19	19566-014	IC 3 TO 8 LINE DCDR/DMUXR	NATIONAL SEMICONDUCTOR	74HC138N
A1U20	19566-038	IC,HEX INV W/OPEN DRAIN	MOTOROLA (SPD)	MC74HC05N
A1U21	19566-039	IC,8-3 LINE PRI ENCODER	TEXAS INSTRUMENT	SN74HC148N
A1U22	21163	IC,PWR MONITOR	DALLAS SC	DS1231-50
A1U23	17024	INTEGRATED CKT D8279	INTEL	D8279
A1U24	17048-014	IC,HEX INV SCHMITT TRIG	MOTOROLA (SPD)	MC74HCT14AN
A1U25	21159	IC,PARALLEL INTFC	NEC	uPD71055C
A1U27	21165	IC 1M 8 BIT STATIC RAM	TOSHIBA AMERICA INC.	TC551001PL-10
A1U28	21165	IC 1M 8 BIT STATIC RAM	TOSHIBA AMERICA INC.	TC551001PL-10
A1U37	13479-001	INTEGRATED CIRCUIT LM340 T-5	NATIONAL SEMICONDUCTOR	LM340T-5
A1U38	13479-001	INTEGRATED CIRCUIT LM340 T-5	NATIONAL SEMICONDUCTOR	LM340T-5
A1U39	18737	VOLTAGE REGULATOR	TEXAS INSTRUMENTS	UA7815C
A1U40	18739	VOLTAGE REGULATOR	TEXAS INSTRUMENTS	UA7915CKC
A1W3	14514-001	MOD 2 POST	AUTOSPLICE	8-25304432
A1W4	14514-001	MOD 2 POST	AUTOSPLICE	8-25304432
A1W3A	17240-001	JUMPER, INSULATED 2 POS	MOLEX, INC.	15-38-1024
A1W3B	17240-001	JUMPER, INSULATED 2 POS	MOLEX, INC.	15-38-1024
A1W3C	17240-001	JUMPER, INSULATED 2 POS	MOLEX, INC.	15-38-1024
A1W3D	17240-001	JUMPER, INSULATED 2 POS	MOLEX, INC.	15-38-1024
A1W3H	17240-001	JUMPER, INSULATED 2 POS	MOLEX, INC.	15-38-1024
A1XU4	10978-006	IC SOCKET, 20 PIN	AMP, INC.	2-641870-1
A1XU27	10978-012	IC SOCKET, 32 PIN	AMP, INC.	644018-2
A1XU28	10978-012	IC SOCKET, 32 PIN	AMP, INC.	644018-2
A1XU29	10978-012	IC SOCKET, 32 PIN	AMP, INC.	644018-2
A1XU30	10978-012	IC SOCKET, 32 PIN	AMP, INC	644018-2
A1XU31	10978-012	IC SOCKET, 32 PIN	AMP, INC.	644018-2
A1XU32	10978-012	IC SOCKET, 32 PIN	AMP, INC	644018-2
A1XU33	10978-012	IC SOCKET, 32 PIN	AMP, INC	644018-2

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A1XU34	10978-012	IC SOCKET, 32 PIN	AMP, INC.	644018-2
A1XU35	10978-012	IC SOCKET, 32 PIN	AMP, INC.	644018-2
A1XU36	10978-012	IC SOCKET, 32 PIN	AMP, INC.	644018-2
A1Y1	21166	XTAL OSC,24MHz	FOX ELECTRONICS	F1100E 24.0000MHz
A1Y2	17047-001	CRYSTAL, QUARTZ 32.768 KHZ	SARONIX	NTF3226E

8541 ANALOG PC BOARD ASSEMBLY #21181-001

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A2A1	20112	CALIB THERM OVEN PCB ASSY	WAVETEK MICROWAVE	20112
A2C10	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C11	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C12	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C13	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C14	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C15	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C17	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C18	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C19	18831	CAP,MICA,1000PF,100V,5%	ARCO	DM15-102J
A2C20	18831	CAP,MICA,1000PF,100V,5%	ARCO	DM15-102J
A2C21	18831	CAP,MICA,1000PF,100V,5%	ARCO	DM15-102J
A2C22	18831	CAP,MICA,1000PF,100V,5%	ARCO	DM15-102J
A2C23	21327-001	CAP,MICA,820pF,1%,300V	CORNEL-DUBILIER	CD15FC821F03
A2C24	21327-001	CAP,MICA,820pF,1%,300V	CORNEL-DUBILIER	CD15FC821F03
A2C25	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C26	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C27	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C28	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C29	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C30	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C31	19599-001	CAP ELCTLT RDL 10uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H100MAA
A2C33	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C34	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C35	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C36	10001-005	CAP CER 33PF 5% 1000VDC	SPRAGUE ELECTRIC CO.	10TCC-Q33
A2C37	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C38	15776-010	CAP, CER .22UF 10% 50V	PHILLIPS/CENTRALAB	CW30C224K
A2C39	20032-001	CAP POLYPRO 0.47MF 160V 5%	WIMA	MKP-4 0.47/160/5
A2C40	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C41	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C42	19599-004	CAP ELCTLT RDL 4.7uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H4R7MAA
A2C43	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C44	19599-004	CAP ELCTLT RDL 4.7uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H4R7MAA
A2C45	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C46	19599-004	CAP ELCTLT RDL 4.7uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H4R7MAA
A2C47	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C48	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C49	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C50	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C51	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C52	10909-013	CAP MICA 150PF 1% 500V	ARCO	DM15-151F
A2C53	10909-018	CAP, SLVR MICA 240pF 1% 500V	ARCO	DM15-241F
A2C54	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C55	10909-011	CAP. SILVER MICA 62 PF	ARCO	CM05FD620F03
A2C56	10909-012	CAP MICA 120PF 1% 500V	ARCO	CM06FD121J03
A2C57	10909-011	CAP. SILVER MICA 62 PF	ARCO	CM05FD620F03
A2C58	10677-018	CAP MICA 1000PF 5% 500V	ARCO	DM15102J100V
A2C59	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C60	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C61	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C62	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C63	10677-018	CAP MICA 1000PF 5% 500V	ARCO	DM15102J100V
A2C64	15640-001	CAP CER USTBLE 100PF 10% 100V	SPRAGUE ELECTRIC CO.	1CCOG101X9100C4
A2C65	15640-001	CAP CER USTBLE 100PF 10% 100V	SPRAGUE ELECTRIC CO.	1CCOG101X9100C4

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A2C66	15640-001	CAP CER USTBLE 100PF 10% 100V	SPRAGUE ELECTRIC CO.	1CC00101X9100C4
A2C67	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C68	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C69	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C70	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C71	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C72	15640-001	CAP CER USTBLE 100PF 10% 100V	SPRAGUE ELECTRIC CO.	1CC00101X9100C4
A2C73	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C74	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C75	15776-010	CAP, CER .22UF 10% 50V	PHILLIPS/CENTRALAB	CW30C224K
A2C76	10001-001	CAP CER 2.2PF 5% 1000VDC	SPRAGUE ELECTRIC CO.	10TCC-V22
A2C77	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C78	15776-002	CAP, CER .001 MF 10% 50V	PHILLIPS/CENTRALAB	CW15C102K
A2C79	15640-001	CAP CER USTBLE 100PF 10% 100V	SPRAGUE ELECTRIC CO.	1CC00101X9100C4
A2C80	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C81	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C82	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C83	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C84	15776-008	CAP CER .047 MFD 10% 50V	PHILLIPS/CENTRALAB	CW20C473K
A2C85	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C86	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C87	15776-002	CAP, CER .001 MF 10% 50V	PHILLIPS/CENTRALAB	CW15C102K
A2C88	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C90	15776-002	CAP, CER .001 MF 10% 50V	PHILLIPS/CENTRALAB	CW15C102K
A2C91	15640-001	CAP CER USTBLE 100PF 10% 100V	SPRAGUE ELECTRIC CO.	1CC00101X9100C4
A2C92	15640-001	CAP CER USTBLE 100PF 10% 100V	SPRAGUE ELECTRIC CO.	1CC00101X9100C4
A2C93	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C94	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C100	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C101	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C102	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C103	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C104	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C105	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C106	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C107	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C108	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C109	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C110	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C112	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C124	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C126	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C127	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C128	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C129	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C130	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C131	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C132	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C133	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C134	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C135	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C136	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C137	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C138	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C139	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C140	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C141	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C142	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C143	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A2C144	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C145	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C147	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C148	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C149	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C150	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C151	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C152	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C153	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C154	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C155	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C156	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C157	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C158	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C159	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C160	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C161	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C162	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C163	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C165	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C166	19599-001	CAP ELCTLT RDL 10uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H100MAA
A2C171	19599-001	CAP ELCTLT RDL 10uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H100MAA
A2C172	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C173	19599-001	CAP ELCTLT RDL 10uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H100MAA
A2C174	19599-001	CAP ELCTLT RDL 10uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H100MAA
A2C175	19599-001	CAP ELCTLT RDL 10uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H100MAA
A2C176	19599-001	CAP ELCTLT RDL 10uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H100MAA
A2CR1	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR2	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR3	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR4	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR5	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR6	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR7	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR8	13618	DIODE,uWAVE PIN SW,.3PF,100ns	SDI	PER WMI PRINT
A2CR9	13618	DIODE,uWAVE PIN SW,.3PF,100ns	SDI	PER WMI PRINT
A2CR10	13618	DIODE,uWAVE PIN SW,.3PF,100ns	SDI	PER WMI PRINT
A2CR11	13618	DIODE,uWAVE PIN SW,.3PF,100ns	SDI	PER WMI PRINT
A2CR12	13618	DIODE,uWAVE PIN SW,.3PF,100ns	SDI	PER WMI PRINT
A2CR13	13618	DIODE,uWAVE PIN SW,.3PF,100ns	SDI	PER WMI PRINT
A2CR14	13618	DIODE,uWAVE PIN SW,.3PF,100ns	SDI	PER WMI PRINT
A2CR15	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR16	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR17	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR20	20064	DIODE, ZENER 5.1V +-5%	MOTOROLA (SPD)	1N751A
A2J1	19941-001	CONN HDR ANG 2ROWS .1OSP 14POS	AMP, INC.	103024-7
A2J2	19941-001	CONN HDR ANG 2ROWS .1OSP 14POS	AMP, INC.	103024-7
A2J3	21164	CONN,BNC,RT ANG,PC MTG	AMP INC.	413524-1
A2J4	21164	CONN,BNC,RT ANG,PC MTG	AMP INC.	413524-1
A2J5	13271	COUPLING STRAIGHT JACK	M/A-COM OMNI SPECTRA, INC	700209
A2L11	10631-010	COIL, RF MLD 6.8uH 10%	DELEVAN	1025-40
A2L12	19203	RF COIL 0.1uH	TOKIN MAGNETICS, INC.	PER WMI PRINT
A2L13	15293	COIL, RF .17uH	ZAMBRE CO	PER WMI PRINT
A2L14	15293	COIL, RF .17uH	ZAMBRE CO	PER WMI PRINT
A2L15	15293	COIL, RF .17uH	ZAMBRE CO	PER WMI PRINT
A2L16	10631-010	COIL, RF MLD 6.8uH 10%	DELEVAN	1025-40
A2L17	10631-010	COIL, RF MLD 6.8uH 10%	DELEVAN	1025-40
A2L18	10631-010	COIL, RF MLD 6.8uH 10%	DELEVAN	1025-40

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A2P1	16570	HEADER DOUBLE ROW 50 POS	AMP, INC.	2-87227-5
A2Q1	11531	TRANSISTOR 2N2218	FAIRCHILD	2N2218
A2Q1	21287	TRANSISTOR,PNP,MJE170	MOTOROLA (SPD)	MJE170
A2Q2	13634	TRANSISTOR 2N3904	FAIRCHILD	2N3904
A2Q4	20242	TRANSISTOR, NPN 2N3553	TEXAS INSTRUMENTS	2N3553
A2Q5	10023	TRANSISTOR 2N3644	NATIONAL SEMICONDUCTOR	3644
A2Q6	10017	TRANSISTOR 2N3569	NATIONAL SEMICONDUCTOR	0
A2Q7	10017	TRANSISTOR 2N3569	NATIONAL SEMICONDUCTOR	0
A2Q8	13634	TRANSISTOR 2N3904	FAIRCHILD	2N3904
A2R1	12449-033	RES MF 100K OHM 0.1% 1/8W	ACI	EE 1/8 C2
A2R2	12449-033	RES MF 100K OHM 0.1% 1/8W	ACI	EE 1/8 C2
A2R4	10015-207	RES MET FILM 20.0K OHM 1% 1/8W	CORNING GLASS WORKS	20K OHM 1%
A2R5	10015-207	RES MET FILM 20.0K OHM 1% 1/8W	CORNING GLASS WORKS	20K OHM 1%
A2R6	10015-060	RES MET FILM 19.6K OHM 1% 1/8W	LARTRONICS, INC.	RN55D 19.6K OHM 1% 1/8W
A2R7	10015-202	RES MET FILM 274 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 274 OHM 1%
A2R8	10015-126	RES MET FILM 34 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D
A2R9	10015-360	RES MF 9.76 1% 1/8W	RODERSTEIN ELECTRONICS, I	MK2 9.76 OHM 1%
A2R10	10015-126	RES MET FILM 34 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D
A2R11	10015-202	RES MET FILM 274 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 274 OHM 1%
A2R12	10015-060	RES MET FILM 19.6K OHM 1% 1/8W	LARTRONICS, INC.	RN55D 19.6K OHM 1% 1/8W
A2R15	10015-118	RES MET FILM 28.7K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 28.7K OHM 1%
A2R16	12449-148	RES MF 70.00K OHM 0.1% 1/8W	PRECISION RESISTIVE PRODU	GP1/4 TC50 70.00K 0.1%
A2R17	12449-147	RES MF 8.750K OHM 0.1% 1/8W	PRECISION RESISTIVE PRODU	GP1/4 TC50 8.750K 0.1%
A2R18	12449-032	RES MF 1.250K OHM 0.1% 1/8W	ACI	EE 1/8 C2
A2R19	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R20	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R21	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R22	10015-159	RES MET FILM 402 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 402 OHM 1%
A2R23	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R24	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R25	10015-289	RES,MF,1/8W,1%,3.65K	NOT FOUND	RN55D-3651F
A2R26	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R27	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R28	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R29	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R30	10013-025	RES DEP CARB 1K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R31	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC07GF470J
A2R32	10013-017	RES DEP CARB 220 OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R33	10013-028	RES DEP CARB 1.8K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R34	10013-049	RES DEP CARB 100K OHM 5% 1/4W	MEPCO/ELECTRA	CR25 100K 5%
A2R35	10013-033	RES DEP CARB 4.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R36	10015-116	RES MET FILM 30.1K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 30.1K OHM 1%
A2R37	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R38	10015-233	RES MET FILM 174K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 174K OHM 1%
A2R39	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R40	10015-207	RES MET FILM 20.0K OHM 1% 1/8W	CORNING GLASS WORKS	20K OHM 1%
A2R41	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R42	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R43	10013-056	RES CARB FILM 390K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FXXXJ
A2R44	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R45	10015-054	RES MET FILM 110K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 110K OHM 1%
A2R46	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R77	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R78	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R79	10015-247	RES MET FILM 22.1K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 22.1K OHM 1%
A2R80	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R81	10013-045	RES DEP CARB 47K OHM 5% 1/4W	MEPCO/ELECTRA	CR25 47K 5%
A2R82	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A2R83	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R84	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R87	10015-233	RES MET FILM 174K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 174K OHM 1%
A2R88	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R90	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R92	10013-056	RES CARB FILM 390K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FXXXJ
A2R93	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R95	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R96	10013-049	RES DEP CARB 100K OHM 5% 1/4W	MEPCO/ELECTRA	CR25 100K 5%
A2R97	10013-028	RES DEP CARB 1.8K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R99	10013-006	RES DEP CARB 27 OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R100	12449-053	RES MF 50.00K OHM 0.1% 1/8W	DALE ELECTRONICS	MMF 1/8 T2
A2R101	12449-053	RES MF 50.00K OHM 0.1% 1/8W	DALE ELECTRONICS	MMF 1/8 T2
A2R102	12449-053	RES MF 50.00K OHM 0.1% 1/8W	DALE ELECTRONICS	MMF 1/8 T2
A2R103	12449-053	RES MF 50.00K OHM 0.1% 1/8W	DALE ELECTRONICS	MMF 1/8 T2
A2R104	10013-089	RES CARB FILM 200 OHM 5% 1/4W	MEPCO/ELECTRA	BB03 104NB 201
A2R105	10013-086	RES CARB FILM 51 OHM 5% 1/4W	MEPCO/ELECTRA	BB03 104NB 510
A2R107	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R108	10013-020	RES DEP CARB 390 OHM 5% 1/4W	MEPCO/ELECTRA	CR25-390 OHM 5%
A2R113	10013-045	RES DEP CARB 47K OHM 5% 1/4W	MEPCO/ELECTRA	CR25 47K 5%
A2R114	10013-025	RES DEP CARB 1K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R115	10015-064	RES MET FILM 1.13K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1.13K OHM 1%
A2R117	12449-048	RES MF 15.00K OHM 0.1% 1/8W	DALE ELECTRONICS	MFF 1/8 T2
A2R118	12449-032	RES MF 1.250K OHM 0.1% 1/8W	ACI	EE 1/8 C2
A2R119	12449-028	RES MF 12.5K OHM 0.1% 1/8W	ACI	EE 1/8 C2
A2R120	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R121	10013-061	RES DEP CARB 1M OHM 5% 1/4W	MEPCO/ELECTRA	BB03 104NB 105
A2R122	10013-033	RES DEP CARB 4.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R123	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R124	10013-033	RES DEP CARB 4.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R125	10013-033	RES DEP CARB 4.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R126	12449-128	RES MF 13.33K OHM 0.1% 1/8W	NOT FOUND	
A2R127	12449-129	RES MF 40.00K OHM 0.1% 1/8W	NOT FOUND	
A2R128	10015-226	RES MET FILM 2.21K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 2.21K OHM 1%
A2R131	10013-078	RES DEP CARB 2K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R132	10013-078	RES DEP CARB 2K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R133	10013-025	RES DEP CARB 1K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R134	10015-110	RES MET FILM 3.01K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 3.01K OHM 1%
A2R135	10015-247	RES MET FILM 22.1K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 22.1K OHM 1%
A2R136	10015-014	RES MET FILM 31.6K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 31.6K OHM 1%
A2R137	10015-098	RES MET FILM 13.3K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 13.3K OHM 1%
A2R138	10013-031	RES DEP CARB 3.3K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R139	10013-025	RES DEP CARB 1K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R140	10015-065	RES MET FILM 4.99K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 4.99K OHM 1%
A2R141	12449-090	RES MF 8.000K OHM 0.1% 1/8W	PRECISION RESISTIVE PRODU	OP 1/4 TC50
A2R142	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R143	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R144	10013-006	RES DEP CARB 27 OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxxx
A2R146	10015-047	RES MET FILM 2.49K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 2.49K OHM 1%
A2R147	10015-047	RES MET FILM 2.49K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 2.49K OHM 1%
A2R148	10015-096	RES MET FILM 12.1K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 12.1K OHM 1%
A2R149	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R150	10015-112	RES MET FILM 374 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 374K OHM 1%
A2R151	10015-112	RES MET FILM 374 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 374K OHM 1%
A2R152	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R153	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R154	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R155	10015-140	RES MET FILM 499 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 499 OHM 1%
A2R156	10015-140	RES MET FILM 499 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 499 OHM 1%

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A2R157	10015-082	RES MET FILM 61.9 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 61.9K OHM 1%
A2R158	10015-144	RES MET FILM 95.3 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 95.3 OHM 1%
A2R159	10015-144	RES MET FILM 95.3 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 95.3 OHM 1%
A2R160	10015-256	RES MET FILM 1.5K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1.5K OHM 1%
A2R161	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R162	10015-125	RES MET FILM 28.7 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 28.7 OHM 1% 1/8W
A2R163	10015-122	RES MET FILM 11.0 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 11 OHM 1%
A2R164	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R165	10015-140	RES MET FILM 499 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 499 OHM 1%
A2R166	10015-082	RES MET FILM 61.9 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 61.9K OHM 1%
A2R167	10015-200	RES MET FILM 243 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 243 OHM 1%
A2R168	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R169	10015-140	RES MET FILM 499 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 499 OHM 1%
A2R170	10015-082	RES MET FILM 61.9 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 61.9K OHM 1%
A2R171	10015-116	RES MET FILM 30.1K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 30.1K OHM 1%
A2R172	10015-054	RES MET FILM 110K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 110K OHM 1%
A2R173	10013-030	RES DEP CARB 2.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxx J
A2R174	11845-004	RES MTL GLAZE 15 OHM 10% 2W	CORNING GLASS WORKS	FP-2
A2R175	10013-027	RES DEP CARB 1.5K OHM 1/4W	MEPCO/ELECTRA	B803 104NB 152
A2R176	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxx J
A2R177	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxx J
A2R178	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxx J
A2R179	10013-041	RES DEP CARB 22K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxx J
A2R180	10013-039	RES DEP CARB 15K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxx J
A2R181	10013-033	RES DEP CARB 4.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxx J
A2R182	10013-033	RES DEP CARB 4.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxx J
A2R183	10015-046	RES MET FILM 249 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 249 OHM 1%
A2R184	10013-057	RES DEP CARB 470K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxx J
A2R185	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R186	10015-074	RES MET FILM 2.0K OHM 1% 1.8W	LARTRONICS, INC.	RN55D 2.0K OHM 1% 1/8W
A2R187	10013-001	RES DEP CARB 10 OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxx J
A2R190	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R191	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R194	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxx J
A2R195	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxx J
A2R196	10015-051	RES MET FILM 15.4K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 15.4K OHM 1%
A2R197	10015-051	RES MET FILM 15.4K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 15.4K OHM 1%
A2R198	10015-186	RES MET FILM 10.0 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 10 OHM 1%
A2R199	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R204	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R205	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R206	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R207	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R228	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R229	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R232	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R233	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R234	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R235	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R240	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R241	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R242	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R243	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC	RC070F470J
A2R246	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC	RC070F470J
A2R247	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R248	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC	RC070F470J
A2R249	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R250	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxx J

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A2R251	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RCD72FxxxJ
A2RP1	14882-001	RES NETWK 10K OHM 2% 125MW	ALLEN-BRADLEY CO.	110A103
A2RP2	14882-001	RES NETWK 10K OHM 2% 125MW	ALLEN-BRADLEY CO.	110A103
A2RP3	14882-001	RES NETWK 10K OHM 2% 125MW	ALLEN-BRADLEY CO.	110A103
A2RT1	19425-001	THERMISTOR, GLASS BEAD 51K OHM	THERMOMETRICS	BR16PB513N
A2RT1	20607-002	THMS, PTC 0.75 OHM 0.5A(HOLD)	RAYCHEM CORPORATION	RXE050
A2RT2	15208-001	THERMISTOR, PARALLEL 10K OHM	QUALITY THERMISTOR, INC.	PER WMI PRINT
A2RT2	19425-001	THERMISTOR, GLASS BEAD 51K OHM	THERMOMETRICS	BR16PB513N
A2RT3	20607-002	THMS, PTC 0.75 OHM 0.5A(HOLD)	RAYCHEM CORPORATION	RXE050
A2RT4	20607-002	THMS, PTC 0.75 OHM 0.5A(HOLD)	RAYCHEM CORPORATION	RXE050
A2TP1	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP2	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP3	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP4	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP5	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP6	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP7	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP8	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP11	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP12	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP13	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2U1	15135	INTEGRATED CKT HA7-5135-5	PRECISION MONOLITHICS	OP-07/CP
A2U2	21189	IC SPST CMOS ANALOG SWITHCHES	SILICONIX	DG411DJ
A2U3	15233	I C CA3240E DUAL BIMOS OP AMP	RCA	CA3240E
A2U4	15135	INTEGRATED CKT HA7-5135-5	PRECISION MONOLITHICS	OP-07/CP
A2U5	15491	LINEAR IC, DUAL COMPARATOR	NATIONAL SEMICONDUCTOR	LM393N
A2U6	15093	INTEGRATED CKT LM399H	NATIONAL SEMICONDUCTOR	LM399H
A2U7	15135	INTEGRATED CKT HA7-5135-5	PRECISION MONOLITHICS	OP-07/CP
A2U8	21189	IC SPST CMOS ANALOG SWITHCHES	SILICONIX	DG411DJ
A2U9	19566-009	IC QUAD 2-INP OR GATE	NATIONAL SEMICONDUCTOR	74HC32N
A2U10	19566-004	IC-Quad 2-input AND Gate	NATIONAL SEMICONDUCTOR	74HC08N
A2U11	15135	INTEGRATED CKT HA7-5135-5	PRECISION MONOLITHICS	OP-07/CP
A2U12	15135	INTEGRATED CKT HA7-5135-5	PRECISION MONOLITHICS	OP-07/CP
A2U13	17035	I.C. - DIGITAL TTL	ANALOG DEVICES	AD7534JN
A2U14	19586	IC, 256 BIT NONVOL STATIC RAM	XICOR	X2444P
A2U15	19566-003	IC HEX INV	NATIONAL SEMICONDUCTOR	74HC04
A2U16	13471	INTEGRATED CKT LM324N	SGS	LM324AN
A2U18	21159	IC,PARALLEL INTFC	NEC	uPD71055C
A2U19	13471	INTEGRATED CKT LM324N	SGS	LM324AN
A2U20	21187	IC 12-BIT DACPORTS	ANALOG DEVICES	AD7245JN
A2U21	21159	IC,PARALLEL INTFC	NEC	uPD71055C
A2U27	21188	IC CMOS ANALOG MULTIPLEXERS	SILICONIX	DG409DJ
A2U28	21188	IC CMOS ANALOG MULTIPLEXERS	SILICONIX	DG409DJ
A2U29	21185	IC,PROG GAIN INSTR AMPL	ANALOG DEVICES	AD625JN
A2U30	19343	IC,QUAD PRECISION OP AMP	LINEAR TECHNOLOGY	LT1014DN
A2U31	21188	IC CMOS ANALOG MULTIPLEXERS	SILICONIX	DG409DJ
A2U32	15141	IC, VOLT QUAD COMP LM339N	NATIONAL SEMICONDUCTOR	LM339N
A2U33	21186	IC 14-BIT 100 KSPS	ANALOG DEVICES	AD779JN
A2U34	21191	IC 3-TERMINAL NEG REGULATOR	NATIONAL SEMICONDUCTOR	LM79L12ACZ
A2U35	20555	IC +12V OUTPUT VOLT REG	MOTOROLA (SPD)	MC78L12ACP
A2U36	21190	IC CMOS ANALOG MULTIPLEXERS	SILICONIX	DG506ACJ
A2U37	21187	IC 12-BIT DACPORTS	ANALOG DEVICES	AD7245JN
A2U38	17714	INTEGRATED CKT LM358AN	TEXAS INSTRUMENTS	LM358AP
A2U39	13471	INTEGRATED CKT LM324N	SGS	LM324AN
A2U40	15141	IC, VOLT QUAD COMP LM339N	NATIONAL SEMICONDUCTOR	LM339N
A2U41	17048-014	IC,HEX INV SCHMITT TRIG	MOTOROLA (SPD)	MC74HCT14AN
A2W1	14514-001	MOD 2 POST	AUTOSPLICE	8-25304432
A2XQ4	11037	SPACER, NYLON TO-5	THERMALLOY	7717-22-N

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A2XU2	10978-002	IC SOCKET, 16 PIN	AMP, INC.	2-641868-1
A2XU3	10978-004	IC SOCKET, 8 PIN	AMP, INC.	2-641866-1
A2XU8	10978-002	IC SOCKET, 16 PIN	AMP, INC.	2-641868-1
A2XU20	17069-002	IC SKT 24 PIN-LOW PROFILE(DL)	CAMBION	703-1523-01-04-10
A2XU27	10978-002	IC SOCKET, 16 PIN	AMP, INC.	2-641868-1
A2XU28	10978-002	IC SOCKET, 16 PIN	AMP, INC.	2-641868-1
A2XU29	10978-002	IC SOCKET, 16 PIN	AMP, INC.	2-641868-1
A2XU30	10978-001	IC SOCKET, 14 PIN	AMP, INC.	2-641867-1
A2XU31	10978-002	IC SOCKET, 16 PIN	AMP, INC.	2-641868-1
A2XU32	10978-001	IC SOCKET, 14 PIN	AMP, INC.	2-641867-1
A2XU33	10978-009	IC SOCKET, 28 PIN	AMP, INC.	2-641873-1
A2XU36	10978-009	IC SOCKET, 28 PIN	AMP, INC.	2-641873-1
A2XU37	17069-002	IC SKT 24 PIN-LOW PROFILE(DL)	CAMBION	703-1523-01-04-10
A2XU40	10978-001	IC SOCKET, 14 PIN	AMP, INC.	2-641867-1
A2XW1	17240-001	JUMPER, INSULATED 2 POS	MOLEX, INC.	15-38-1024

8542 ANALOG PC BOARD ASSEMBLY #21181

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A2A1	20112	CALIB THERM OVEN PCB ASSY	WAVETEK MICROWAVE	20112
A2C4	18831	CAP,MICA,1000PF,100V,5%	ARCO	DM15-102J
A2C5	18831	CAP,MICA,1000PF,100V,5%	ARCO	DM15-102J
A2C6	18831	CAP,MICA,1000PF,100V,5%	ARCO	DM15-102J
A2C7	18831	CAP,MICA,1000PF,100V,5%	ARCO	DM15-102J
A2C8	21327-001	CAP,MICA,820pF,1%,300V	CORNEL-DUBILIER	CD15FC821F03
A2C9	21327-001	CAP,MICA,820pF,1%,300V	CORNEL-DUBILIER	CD15FC821F03
A2C10	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C11	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C12	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C13	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C14	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C15	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C17	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C18	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C19	18831	CAP,MICA,1000PF,100V,5%	ARCO	DM15-102J
A2C20	18831	CAP,MICA,1000PF,100V,5%	ARCO	DM15-102J
A2C21	18831	CAP,MICA,1000PF,100V,5%	ARCO	DM15-102J
A2C22	18831	CAP,MICA,1000PF,100V,5%	ARCO	DM15-102J
A2C23	21327-001	CAP,MICA,820pF,1%,300V	CORNEL-DUBILIER	CD15FC821F03
A2C24	21327-001	CAP,MICA,820pF,1%,300V	CORNEL-DUBILIER	CD15FC821F03
A2C25	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C26	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C27	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C28	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C29	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C30	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C31	19599-001	CAP ELCTLT RDL 10uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H100MAA
A2C33	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C34	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C35	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C36	10001-005	CAP CER 33PF 5% 1000VDC	SPRAGUE ELECTRIC CO.	10TCC-Q33
A2C37	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C38	15776-010	CAP, CER .22UF 10% 50V	PHILLIPS/CENTRALAB	CW30C224K
A2C39	20032-001	CAP POLYPRO 0.47MF 160V 5%	WIMA	MKP-4 0.47/160/5
A2C40	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C41	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C42	19599-004	CAP ELCTLT RDL 4.7uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H4R7MAA
A2C43	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C44	19599-004	CAP ELCTLT RDL 4.7uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H4R7MAA
A2C45	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C46	19599-004	CAP ELCTLT RDL 4.7uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H4R7MAA
A2C47	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C48	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C49	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C50	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C51	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C52	10909-013	CAP MICA 150PF 1% 500V	ARCO	DM15-151F
A2C53	10909-018	CAP, SLVR MICA 240pF 1% 500V	ARCO	DM15-241F
A2C54	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C55	10909-011	CAP. SILVER MICA 62 PF	ARCO	CM05FD620F03
A2C56	10909-012	CAP MICA 120PF 1% 500V	ARCO	CM06FD121J03
A2C57	10909-011	CAP. SILVER MICA 62 PF	ARCO	CM05FD620F03
A2C58	10677-018	CAP MICA 1000PF 5% 500V	ARCO	DM15102J100V
A2C59	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A2C60	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C61	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C62	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C63	10677-018	CAP MICA 1000PF 5% 500V	ARCO	DM15102J100V
A2C64	15640-001	CAP CER USTBLE 100PF 10% 100V	SPRAGUE ELECTRIC CO.	1CC00101X9100C4
A2C65	15640-001	CAP CER USTBLE 100PF 10% 100V	SPRAGUE ELECTRIC CO.	1CC00101X9100C4
A2C66	15640-001	CAP CER USTBLE 100PF 10% 100V	SPRAGUE ELECTRIC CO.	1CC00101X9100C4
A2C67	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C68	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C69	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C70	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C71	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C72	15640-001	CAP CER USTBLE 100PF 10% 100V	SPRAGUE ELECTRIC CO.	1CC00101X9100C4
A2C73	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C74	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C75	15776-010	CAP, CER .22UF 10% 50V	PHILLIPS/CENTRALAB	CW30C224K
A2C76	10001-001	CAP CER 2.2PF 5% 1000VDC	SPRAGUE ELECTRIC CO.	10TCC-V22
A2C77	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C78	15776-002	CAP, CER .001 MF 10% 50V	PHILLIPS/CENTRALAB	CW15C102K
A2C79	15640-001	CAP CER USTBLE 100PF 10% 100V	SPRAGUE ELECTRIC CO.	1CC00101X9100C4
A2C80	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C81	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C82	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C83	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C84	15776-008	CAP CER .047 MFD 10% 50V	PHILLIPS/CENTRALAB	CW20C473K
A2C85	15776-004	CAP,CER .0022 MFD 10% 50V	PHILLIPS/CENTRALAB	CW15C222K
A2C86	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C87	15776-002	CAP, CER .001 MF 10% 50V	PHILLIPS/CENTRALAB	CW15C102K
A2C88	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C90	15776-002	CAP, CER .001 MF 10% 50V	PHILLIPS/CENTRALAB	CW15C102K
A2C91	15640-001	CAP CER USTBLE 100PF 10% 100V	SPRAGUE ELECTRIC CO.	1CC00101X9100C4
A2C92	15640-001	CAP CER USTBLE 100PF 10% 100V	SPRAGUE ELECTRIC CO.	1CC00101X9100C4
A2C93	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C94	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C95	15776-002	CAP, CER .001 MF 10% 50V	PHILLIPS/CENTRALAB	CW15C102K
A2C96	15640-001	CAP CER USTBLE 100PF 10% 100V	SPRAGUE ELECTRIC CO.	1CC00101X9100C4
A2C97	15640-001	CAP CER USTBLE 100PF 10% 100V	SPRAGUE ELECTRIC CO.	1CC00101X9100C4
A2C98	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C99	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C100	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C101	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C102	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C103	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C104	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C105	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C106	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C107	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C108	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C109	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C110	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C112	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C114	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C115	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C116	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C117	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C118	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C119	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C120	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C121	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A2C122	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C123	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C124	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C126	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C127	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C128	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C129	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C130	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C131	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C132	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C133	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C134	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C135	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C136	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C137	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C138	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C139	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C140	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C141	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C142	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C143	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C144	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C145	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C147	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C148	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C149	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C150	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C151	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C152	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C153	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C154	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C155	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C156	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C157	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C158	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C159	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C160	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C161	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C162	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C163	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C165	15776-005	CAP,CER 0.1 MF 10% 50V	PHILLIPS/CENTRALAB	CW20C104K
A2C166	19599-001	CAP ELCTLT RDL 10uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H100MAA
A2C171	19599-001	CAP ELCTLT RDL 10uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H100MAA
A2C172	15776-001	CAP, CER .01MF 10% 50V	PHILLIPS/CENTRALAB	CW15C103K
A2C173	19599-001	CAP ELCTLT RDL 10uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H100MAA
A2C174	19599-001	CAP ELCTLT RDL 10uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H100MAA
A2C175	19599-001	CAP ELCTLT RDL 10uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H100MAA
A2C176	19599-001	CAP ELCTLT RDL 10uF 20% 50V	NICHICON (AMERICA) CORP.	UVX1H100MAA
A2CR1	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR2	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR3	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR4	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR5	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR6	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR7	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR8	13618	DIODE,uWAVE PIN SW,.3PF,100ns	SDI	PER WMI PRINT
A2CR9	13618	DIODE,uWAVE PIN SW,.3PF,100ns	SDI	PER WMI PRINT
A2CR10	13618	DIODE,uWAVE PIN SW,.3PF,100ns	SDI	PER WMI PRINT

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A2CR11	13618	DIODE,uWAVE PIN SW,.3PF,100ns	SDI	PER WMI PRINT
A2CR12	13618	DIODE,uWAVE PIN SW,.3PF,100ns	SDI	PER WMI PRINT
A2CR13	13618	DIODE,uWAVE PIN SW,.3PF,100ns	SDI	PER WMI PRINT
A2CR14	13618	DIODE,uWAVE PIN SW,.3PF,100ns	SDI	PER WMI PRINT
A2CR15	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR16	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR17	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR18	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR19	10043	DIODE 1N4148/1N914	NATIONAL SEMICONDUCTOR	1N4148
A2CR20	20064	DIODE, ZENER 5.1V +-5%	MOTOROLA (SPD)	1N751A
A2J1	19941-001	CONN HDR ANG 2ROWS .1OSP 14POS	AMP, INC.	103024-7
A2J2	19941-001	CONN HDR ANG 2ROWS .1OSP 14POS	AMP, INC.	103024-7
A2J3	21164	CONN,BNC,RT ANG,PC MTG	AMP INC.	413524-1
A2J4	21164	CONN,BNC,RT ANG,PC MTG	AMP INC.	413524-1
A2J5	13271	COUPLING STRAIGHT JACK	M/A-COM OMNI SPECTRA, INC	700209
A2L11	10631-010	COIL, RF MLD 6.8uH 10%	DELEVAN	1025-40
A2L12	19203	RF COIL 0.1uH	TOKIN MAGNETICS, INC.	PER WMI PRINT
A2L13	15293	COIL, RF .17uH	ZAMBRE CO	PER WMI PRINT
A2L14	15293	COIL, RF .17uH	ZAMBRE CO	PER WMI PRINT
A2L15	15293	COIL, RF .17uH	ZAMBRE CO	PER WMI PRINT
A2L16	10631-010	COIL, RF MLD 6.8uH 10%	DELEVAN	1025-40
A2L17	10631-010	COIL, RF MLD 6.8uH 10%	DELEVAN	1025-40
A2L18	10631-010	COIL, RF MLD 6.8uH 10%	DELEVAN	1025-40
A2P1	16570	HEADER DOUBLE ROW 50 POS	AMP, INC.	2-87227-5
A2Q1	11531	TRANSISTOR 2N2218	FAIRCHILD	2N2218
A2Q1	21287	TRANSISTOR,PNP,MJE170	MOTOROLA (SPD)	MJE170
A2Q2	13634	TRANSISTOR 2N3904	FAIRCHILD	2N3904
A2Q3	13634	TRANSISTOR 2N3904	FAIRCHILD	2N3904
A2Q4	20242	TRANSISTOR, NPN 2N3553	TEXAS INSTRUMENTS	2N3553
A2Q5	10023	TRANSISTOR 2N3644	NATIONAL SEMICONDUCTOR	3644
A2Q6	10017	TRANSISTOR 2N3569	NATIONAL SEMICONDUCTOR	0
A2Q7	10017	TRANSISTOR 2N3569	NATIONAL SEMICONDUCTOR	0
A2Q8	13634	TRANSISTOR 2N3904	FAIRCHILD	2N3904
A2R1	12449-033	RES MF 100K OHM 0.1% 1/8W	ACI	EE 1/8 C2
A2R2	12449-033	RES MF 100K OHM 0.1% 1/8W	ACI	EE 1/8 C2
A2R4	10015-207	RES MET FILM 20.0K OHM 1% 1/8W	CORNING GLASS WORKS	20K OHM 1%
A2R5	10015-207	RES MET FILM 20.0K OHM 1% 1/8W	CORNING GLASS WORKS	20K OHM 1%
A2R6	10015-060	RES MET FILM 19.6K OHM 1% 1/8W	LARTRONICS, INC.	RN55D 19.6K OHM 1% 1/8W
A2R7	10015-202	RES MET FILM 274 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 274 OHM 1%
A2R8	10015-126	RES MET FILM 34 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D
A2R9	10015-360	RES MF 9.76 1% 1/8W	RODERSTEIN ELECTRONICS, I	MK2 9.76 OHM 1%
A2R10	10015-126	RES MET FILM 34 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D
A2R11	10015-202	RES MET FILM 274 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 274 OHM 1%
A2R12	10015-060	RES MET FILM 19.6K OHM 1% 1/8W	LARTRONICS, INC.	RN55D 19.6K OHM 1% 1/8W
A2R15	10015-118	RES MET FILM 28.7K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 28.7K OHM 1%
A2R16	12449-148	RES MF 70.00K OHM 0.1% 1/8W	PRECISION RESISTIVE PRODU	OP1/4 TC50 70.00K 0.1%
A2R17	12449-147	RES MF 8.750K OHM 0.1% 1/8W	PRECISION RESISTIVE PRODU	OP1/4 TC50 8.750K 0.1%
A2R18	12449-032	RES MF 1.250K OHM 0.1% 1/8W	ACI	EE 1/8 C2
A2R19	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R20	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10 0K OHM 1% 1/8W
A2R21	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R22	10015-159	RES MET FILM 402 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 402 OHM 1%
A2R23	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R24	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R25	10015-289	RES,MF,1/8W,1%,3.65K	NOT FOUND	RN55D-3651F
A2R26	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC	10.0K OHM 1% 1/8W
A2R27	10015-007	RES MET FILM 10 0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R28	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A2R29	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R30	10013-025	RES DEP CARB 1K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R31	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC07GF470J
A2R32	10013-017	RES DEP CARB 220 OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R33	10013-028	RES DEP CARB 1.8K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R34	10013-049	RES DEP CARB 100K OHM 5% 1/4W	MEPCO/ELECTRA	CR25 100K 5%
A2R35	10013-033	RES DEP CARB 4.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R36	10015-116	RES MET FILM 30.1K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 30.1K OHM 1%
A2R37	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R38	10015-233	RES MET FILM 174K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 174K OHM 1%
A2R39	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R40	10015-207	RES MET FILM 20.0K OHM 1% 1/8W	CORNING GLASS WORKS	20K OHM 1%
A2R41	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R42	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R43	10013-056	RES CARB FILM 390K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FXXXJ
A2R44	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R45	10015-054	RES MET FILM 110K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 110K OHM 1%
A2R46	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R48	12449-033	RES MF 100K OHM 0.1% 1/8W	ACI	EE 1/8 C2
A2R49	12449-033	RES MF 100K OHM 0.1% 1/8W	ACI	EE 1/8 C2
A2R51	10015-207	RES MET FILM 20.0K OHM 1% 1/8W	CORNING GLASS WORKS	20K OHM 1%
A2R52	10015-207	RES MET FILM 20.0K OHM 1% 1/8W	CORNING GLASS WORKS	20K OHM 1%
A2R53	10015-060	RES MET FILM 19.6K OHM 1% 1/8W	LARTRONICS, INC.	RN55D 19.6K OHM 1% 1/8W
A2R54	10015-202	RES MET FILM 274 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 274 OHM 1%
A2R55	10015-126	RES MET FILM 34 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D
A2R56	10015-360	RES MF 9.76 1% 1/8W	RODERSTEIN ELECTRONICS, I	MK2 9.76 OHM 1%
A2R57	10015-126	RES MET FILM 34 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D
A2R58	10015-202	RES MET FILM 274 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 274 OHM 1%
A2R59	10015-060	RES MET FILM 19.6K OHM 1% 1/8W	LARTRONICS, INC.	RN55D 19.6K OHM 1% 1/8W
A2R62	10015-118	RES MET FILM 28.7K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 28.7K OHM 1%
A2R63	12449-148	RES MF 70.00K OHM 0.1% 1/8W	PRECISION RESISTIVE PRODU	GP1/4 TC50 70.00K 0.1%
A2R64	12449-147	RES MF 8.750K OHM 0.1% 1/8W	PRECISION RESISTIVE PRODU	GP1/4 TC50 8.750K 0.1%
A2R65	12449-032	RES MF 1.250K OHM 0.1% 1/8W	ACI	EE 1/8 C2
A2R66	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R67	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R68	10015-159	RES MET FILM 402 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 402 OHM 1%
A2R69	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R70	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R71	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R72	10015-289	RES,MF,1/8W,1%,3.65K	NOT FOUND	RN55D-3651F
A2R73	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R74	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R75	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R76	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R77	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R78	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R79	10015-247	RES MET FILM 22.1K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 22.1K OHM 1%
A2R80	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R81	10013-045	RES DEP CARB 47K OHM 5% 1/4W	MEPCO/ELECTRA	CR25 47K 5%
A2R82	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R83	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R84	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R85	10015-116	RES MET FILM 30.1K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 30.1K OHM 1%
A2R86	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R87	10015-233	RES MET FILM 174K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 174K OHM 1%
A2R88	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R89	10015-207	RES MET FILM 20.0K OHM 1% 1/8W	CORNING GLASS WORKS	20K OHM 1%
A2R90	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R91	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A2R92	10013-056	RES CARB FILM 390K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FXXXJ
A2R93	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R94	10015-054	RES MET FILM 110K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 110K OHM 1%
A2R95	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R96	10013-049	RES DEP CARB 100K OHM 5% 1/4W	MEPCO/ELECTRA	CR25 100K 5%
A2R97	10013-028	RES DEP CARB 1.8K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R98	10013-033	RES DEP CARB 4.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R99	10013-006	RES DEP CARB 27 OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R100	12449-053	RES MF 50.00K OHM 0.1% 1/8W	DALE ELECTRONICS	MMF 1/8 T2
A2R101	12449-053	RES MF 50.00K OHM 0.1% 1/8W	DALE ELECTRONICS	MMF 1/8 T2
A2R102	12449-053	RES MF 50.00K OHM 0.1% 1/8W	DALE ELECTRONICS	MMF 1/8 T2
A2R103	12449-053	RES MF 50.00K OHM 0.1% 1/8W	DALE ELECTRONICS	MMF 1/8 T2
A2R104	10013-089	RES CARB FILM 200 OHM 5% 1/4W	MEPCO/ELECTRA	B803 104NB 201
A2R105	10013-086	RES CARB FILM 51 OHM 5% 1/4W	MEPCO/ELECTRA	B803 104NB 510
A2R107	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R108	10013-020	RES DEP CARB 390 OHM 5% 1/4W	MEPCO/ELECTRA	CR25-390 OHM 5%
A2R113	10013-045	RES DEP CARB 47K OHM 5% 1/4W	MEPCO/ELECTRA	CR25 47K 5%
A2R114	10013-025	RES DEP CARB 1K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R115	10015-064	RES MET FILM 1.13K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1.13K OHM 1%
A2R117	12449-048	RES MF 15.00K OHM 0.1% 1/8W	DALE ELECTRONICS	MFF 1/8 T2
A2R118	12449-032	RES MF 1.250K OHM 0.1% 1/8W	ACI	EE 1/8 C2
A2R119	12449-028	RES MF 12.5K OHM 0.1% 1/8W	ACI	EE 1/8 C2
A2R120	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R121	10013-061	RES DEP CARB 1M OHM 5% 1/4W	MEPCO/ELECTRA	B803 104NB 105
A2R122	10013-033	RES DEP CARB 4.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R123	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R124	10013-033	RES DEP CARB 4.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R125	10013-033	RES DEP CARB 4.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R126	12449-128	RES MF 13.33K OHM 0.1% 1/8W	NOT FOUND	
A2R127	12449-129	RES MF 40.00K OHM 0.1% 1/8W	NOT FOUND	
A2R128	10015-226	RES MET FILM 2.21K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 2.21K OHM 1%
A2R131	10013-078	RES DEP CARB 2K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R132	10013-078	RES DEP CARB 2K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R133	10013-025	RES DEP CARB 1K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R134	10015-110	RES MET FILM 3.01K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 3.01K OHM 1%
A2R135	10015-247	RES MET FILM 22.1K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 22.1K OHM 1%
A2R136	10015-014	RES MET FILM 31.6K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 31.6K OHM 1%
A2R137	10015-098	RES MET FILM 13.3K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 13.3K OHM 1%
A2R138	10013-031	RES DEP CARB 3.3K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R139	10013-025	RES DEP CARB 1K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R140	10015-065	RES MET FILM 4.99K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 4.99K OHM 1%
A2R141	12449-090	RES MF 8.000K OHM 0.1% 1/8W	PRECISION RESISTIVE PRODU	GP 1/4 TC50
A2R142	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R143	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R144	10013-006	RES DEP CARB 27 OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R146	10015-047	RES MET FILM 2.49K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 2.49K OHM 1%
A2R147	10015-047	RES MET FILM 2.49K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 2.49K OHM 1%
A2R148	10015-096	RES MET FILM 12.1K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 12.1K OHM 1%
A2R149	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R150	10015-112	RES MET FILM 374 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 374K OHM 1%
A2R151	10015-112	RES MET FILM 374 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 374K OHM 1%
A2R152	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R153	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R154	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R155	10015-140	RES MET FILM 499 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 499 OHM 1%
A2R156	10015-140	RES MET FILM 499 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 499 OHM 1%
A2R157	10015-082	RES MET FILM 61 9 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 61 9K OHM 1%
A2R158	10015-144	RES MET FILM 95.3 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 95 3 OHM 1%

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A2R159	10015-144	RES MET FILM 95.3 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 95.3 OHM 1%
A2R160	10015-256	RES MET FILM 1.5K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1.5K OHM 1%
A2R161	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R162	10015-125	RES MET FILM 28.7 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 28.7 OHM 1% 1/8W
A2R163	10015-122	RES MET FILM 11.0 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 11 OHM 1%
A2R164	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R165	10015-140	RES MET FILM 499 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 499 OHM 1%
A2R166	10015-082	RES MET FILM 61.9 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 61.9K OHM 1%
A2R167	10015-200	RES MET FILM 243 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 243 OHM 1%
A2R168	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R169	10015-140	RES MET FILM 499 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 499 OHM 1%
A2R170	10015-082	RES MET FILM 61.9 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 61.9K OHM 1%
A2R171	10015-116	RES MET FILM 30.1K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 30.1K OHM 1%
A2R172	10015-054	RES MET FILM 110K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 110K OHM 1%
A2R173	10013-030	RES DEP CARB 2.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R174	11845-004	RES MTL GLAZE 15 OHM 10% 2W	CORNING GLASS WORKS	FP-2
A2R175	10013-027	RES DEP CARB 1.5K OHM 1/4W	MEPCO/ELECTRA	8803 104NB 152
A2R176	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R177	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R178	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R179	10013-041	RES DEP CARB 22K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R180	10013-039	RES DEP CARB 15K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R181	10013-033	RES DEP CARB 4.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R182	10013-033	RES DEP CARB 4.7K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R183	10015-046	RES MET FILM 249 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 249 OHM 1%
A2R184	10013-057	RES DEP CARB 470K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R185	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R186	10015-074	RES MET FILM 2.0K OHM 1% 1.8W	LARTRONICS, INC.	RN55D 2.0K OHM 1% 1/8W
A2R187	10013-001	RES DEP CARB 10 OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R190	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R191	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R192	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R193	10015-019	RES MET FILM 1.0K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 1K OHM 1%
A2R194	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R195	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A2R196	10015-051	RES MET FILM 15.4K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 15.4K OHM 1%
A2R197	10015-051	RES MET FILM 15.4K OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 15.4K OHM 1%
A2R198	10015-186	RES MET FILM 10.0 OHM 1% 1/8W	CORNING GLASS WORKS	RN55D 10 OHM 1%
A2R199	10015-007	RES MET FILM 10.0K OHM 1% 1/8W	LARTRONICS, INC.	10.0K OHM 1% 1/8W
A2R204	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R205	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R206	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R207	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R218	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R219	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R220	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R221	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R228	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R229	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R232	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R233	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R234	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R235	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R240	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R241	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R242	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R243	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R246	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A2R247	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R248	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R249	10142-008	RES CARB COMP 47 OHM 5% 1/4W	LARTRONICS, INC.	RC070F470J
A2R250	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxx J
A2R251	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072Fxxx J
A2RP1	14882-001	RES NETWK 10K OHM 2% 125MW	ALLEN-BRADLEY CO.	110A103
A2RP2	14882-001	RES NETWK 10K OHM 2% 125MW	ALLEN-BRADLEY CO.	110A103
A2RP3	14882-001	RES NETWK 10K OHM 2% 125MW	ALLEN-BRADLEY CO.	110A103
A2RT1	19425-001	THERMISTOR, GLASS BEAD 51K OHM	THERMOMETRICS	BR16PB513N
A2RT1	20607-002	THMS, PTC 0.75 OHM 0.5A(HOLD)	RAYCHEM CORPORATION	RXE050
A2RT2	15208-001	THERMISTOR, PARALLEL 10K OHM	QUALITY THERMISTOR, INC.	PER WMI PRINT
A2RT2	19425-001	THERMISTOR, GLASS BEAD 51K OHM	THERMOMETRICS	BR16PB513N
A2RT3	20607-002	THMS, PTC 0.75 OHM 0.5A(HOLD)	RAYCHEM CORPORATION	RXE050
A2RT4	20607-002	THMS, PTC 0.75 OHM 0.5A(HOLD)	RAYCHEM CORPORATION	RXE050
A2TP1	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP2	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP3	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP4	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP5	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP6	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP7	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP8	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP9	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP10	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP11	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP12	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2TP13	14320-002	TEST JACK PIN	OVERLAND PRODUCTS	330.100 W/TIN PLATE
A2U1	15135	INTEGRATED CKT HA7-5135-5	PRECISION MONOLITHICS	OP-07/CP
A2U2	21189	IC SPST CMOS ANALOG SWITHCHES	SILICONIX	DG411DJ
A2U3	15233	I C CA3240E DUAL BIMOS OP AMP	RCA	CA3240E
A2U4	15135	INTEGRATED CKT HA7-5135-5	PRECISION MONOLITHICS	OP-07/CP
A2U5	15491	LINEAR IC, DUAL COMPARATOR	NATIONAL SEMICONDUCTOR	LM393N
A2U6	15093	INTEGRATED CKT LM399H	NATIONAL SEMICONDUCTOR	LM399H
A2U7	15135	INTEGRATED CKT HA7-5135-5	PRECISION MONOLITHICS	OP-07/CP
A2U8	21189	IC SPST CMOS ANALOG SWITHCHES	SILICONIX	DG411DJ
A2U9	19566-009	IC QUAD 2-INP OR GATE	NATIONAL SEMICONDUCTOR	74HC32N
A2U10	19566-004	IC-Quad 2-input AND Gate	NATIONAL SEMICONDUCTOR	74HC08N
A2U11	15135	INTEGRATED CKT HA7-5135-5	PRECISION MONOLITHICS	OP-07/CP
A2U12	15135	INTEGRATED CKT HA7-5135-5	PRECISION MONOLITHICS	OP-07/CP
A2U13	17035	I.C. - DIGITAL TTL	ANALOG DEVICES	AD7534JN
A2U14	19586	IC, 256 BIT NONVOL STATIC RAM	XICOR	X2444P
A2U15	19566-003	IC HEX INV	NATIONAL SEMICONDUCTOR	74HC04
A2U16	13471	INTEGRATED CKT LM324N	SGS	LM324AN
A2U17	21187	IC 12-BIT DACPORTS	ANALOG DEVICES	AD7245JN
A2U18	21159	IC,PARALLEL INTFC	NEC	uPD71055C
A2U19	13471	INTEGRATED CKT LM324N	SGS	LM324AN
A2U20	21187	IC 12-BIT DACPORTS	ANALOG DEVICES	AD7245JN
A2U21	21159	IC,PARALLEL INTFC	NEC	uPD71055C
A2U22	21188	IC CMOS ANALOG MULTIPLEXERS	SILICONIX	DG409DJ
A2U23	21188	IC CMOS ANALOG MULTIPLEXERS	SILICONIX	DG409DJ
A2U24	21185	IC,PROG GAIN INSTR AMPL	ANALOG DEVICES	AD625JN
A2U25	19343	IC,QUAD PRECISION OP AMP	LINEAR TECHNOLOGY	LT1014DN
A2U26	21188	IC CMOS ANALOG MULTIPLEXERS	SILICONIX	DG409DJ
A2U27	21188	IC CMOS ANALOG MULTIPLEXERS	SILICONIX	DG409DJ
A2U28	21188	IC CMOS ANALOG MULTIPLEXERS	SILICONIX	DG409DJ
A2U29	21185	IC,PROG GAIN INSTR AMPL	ANALOG DEVICES	AD625JN
A2U30	19343	IC,QUAD PRECISION OP AMP	LINEAR TECHNOLOGY	LT1014DN
A2U31	21188	IC CMOS ANALOG MULTIPLEXERS	SILICONIX	DG409DJ
A2U32	15141	IC, VOLT QUAD COMP LM339N	NATIONAL SEMICONDUCTOR	LM339N

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A2U33	21186	IC 14-BIT 100 KSPS	ANALOG DEVICES	AD779JN
A2U34	21191	IC 3-TERMINAL NEG REGULATOR	NATIONAL SEMICONDUCTOR	LM79L12ACZ
A2U35	20555	IC +12V OUTPUT VOLT REG	MOTOROLA (SPD)	MC78L12ACP
A2U36	21190	IC CMOS ANALOG MULTIPLEXERS	SILICONIX	DG506ACJ
A2U37	21187	IC 12-BIT DACPORTS	ANALOG DEVICES	AD7245JN
A2U38	17714	INTEGRATED CKT LM358AN	TEXAS INSTRUMENTS	LM358AP
A2U39	13471	INTEGRATED CKT LM324N	SGS	LM324AN
A2U40	15141	IC, VOLT QUAD COMP LM339N	NATIONAL SEMICONDUCTOR	LM339N
A2U41	17048-014	IC,HEX INV SCHMITT TRIG	MOTOROLA (SPD)	MC74HCT14AN
A2W1	14514-001	MOD 2 POST	AUTOSPLICE	8-25304432
A2XQ4	11037	SPACER, NYLON TO-5	THERMALLOY	7717-22-N
A2XU2	10978-002	IC SOCKET, 16 PIN	AMP, INC.	2-641868-1
A2XU3	10978-004	IC SOCKET, 8 PIN	AMP, INC.	2-641866-1
A2XU8	10978-002	IC SOCKET, 16 PIN	AMP, INC.	2-641868-1
A2XU17	17069-002	IC SKT 24 PIN-LOW PROFILE(DL)	CAMBION	703-1523-01-04-10
A2XU20	17069-002	IC SKT 24 PIN-LOW PROFILE(DL)	CAMBION	703-1523-01-04-10
A2XU22	10978-002	IC SOCKET, 16 PIN	AMP, INC.	2-641868-1
A2XU23	10978-002	IC SOCKET, 16 PIN	AMP, INC.	2-641868-1
A2XU24	10978-002	IC SOCKET, 16 PIN	AMP, INC.	2-641868-1
A2XU25	10978-001	IC SOCKET, 14 PIN	AMP, INC.	2-641867-1
A2XU26	10978-002	IC SOCKET, 16 PIN	AMP, INC.	2-641868-1
A2XU27	10978-002	IC SOCKET, 16 PIN	AMP, INC.	2-641868-1
A2XU28	10978-002	IC SOCKET, 16 PIN	AMP, INC.	2-641868-1
A2XU29	10978-002	IC SOCKET, 16 PIN	AMP, INC.	2-641868-1
A2XU30	10978-001	IC SOCKET, 14 PIN	AMP, INC.	2-641867-1
A2XU31	10978-002	IC SOCKET, 16 PIN	AMP, INC.	2-641868-1
A2XU32	10978-001	IC SOCKET, 14 PIN	AMP, INC.	2-641867-1
A2XU33	10978-009	IC SOCKET, 28 PIN	AMP, INC.	2-641873-1
A2XU36	10978-009	IC SOCKET, 28 PIN	AMP, INC.	2-641873-1
A2XU37	17069-002	IC SKT 24 PIN-LOW PROFILE(DL)	CAMBION	703-1523-01-04-10
A2XU40	10978-001	IC SOCKET, 14 PIN	AMP, INC.	2-641867-1
A2XW1	17240-001	JUMPER, INSULATED 2 POS	MOLEX, INC.	15-38-1024

FRONT PANEL PC BOARD ASSY #21229

Reference Designator	Part Number	Description	Manufacturer	Manuf. Part Number
A3DS1	21262	LED,10-ELE BAR,GRAPH ARRAY,YEL	HEWLETT PACKARD	HDSP-4840-OPT S22
A3DS2	21262	LED,10-ELE BAR,GRAPH ARRAY,YEL	HEWLETT PACKARD	HDSP-4840-OPT S22
A3J1	14514-001	MOD 2 POST	AUTOSPLICE	8-25304432
A3LS1	15164	MINATURE ENCASED PIEZO-ALARMS	MURATA/ERIE CORP	PKM11-4A0
A3R1	10013-017	RES DEP CARB 220 OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A3R2	10013-017	RES DEP CARB 220 OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A3R6	10013-037	RES DEP CARB 10K OHM 5% 1/4W	MEPCO/ELECTRA	RC072FxxxJ
A3RP1	14882-006	220 Ohm NTWK	DALE ELECTRONICS	MSP10A012210
A3RP2	14882-006	220 Ohm NTWK	DALE ELECTRONICS	MSP10A012210
A3W1	21276-001	JMPR,FLEX,.75LG,.075CTR,10 POS	THOMAS & BETTS CORP.	FST-6 0.75 A-10

CW Power Meters • Peak Power Meters
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Micro Sources • Micro Sweepers

Giga-tronics

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